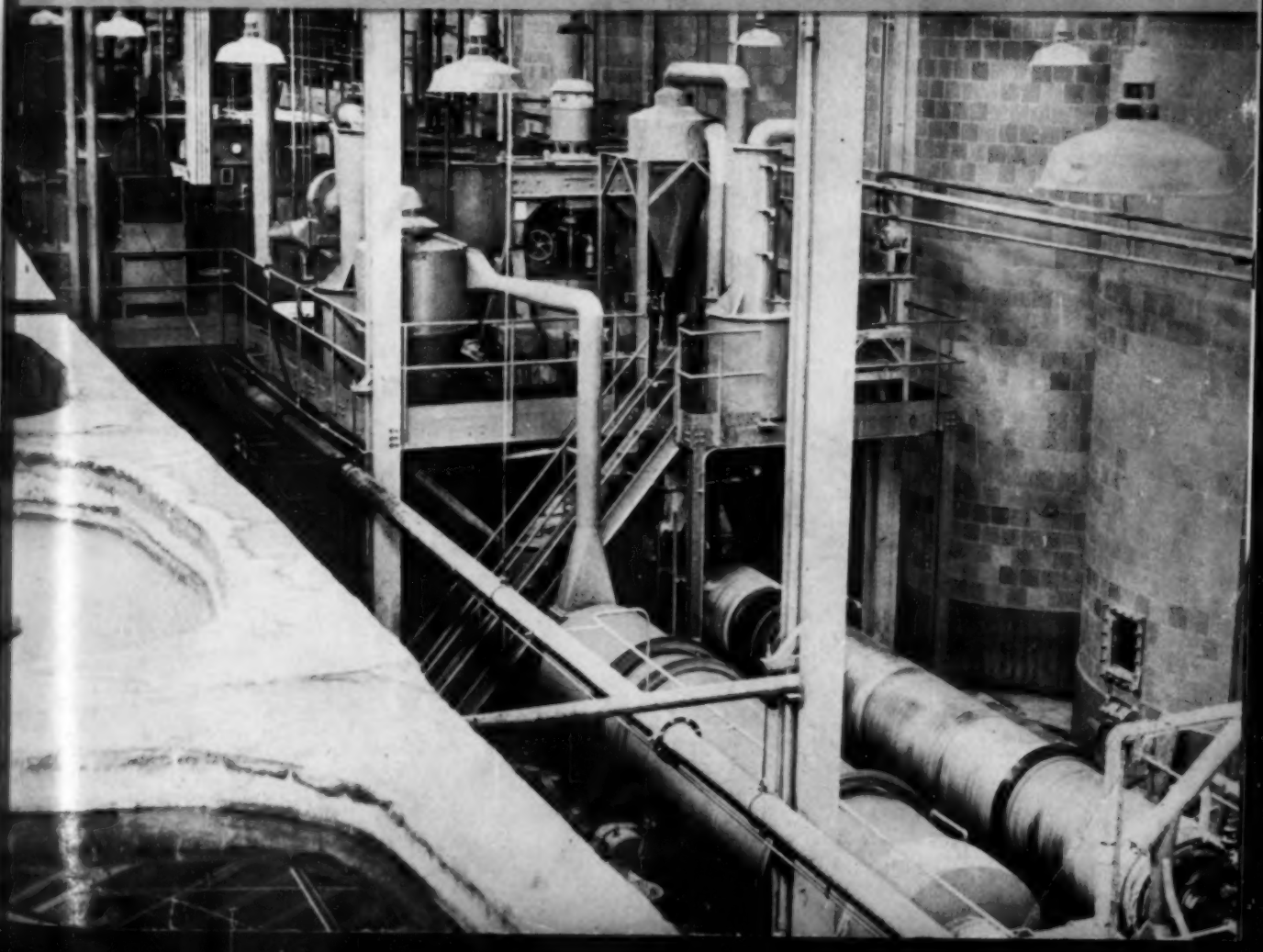
CHEMICAL
& Metallurgical
ENGINEERING

For NOVEMBER, 1944 • BUTYLENE GLYCOL, POSTWAR CHEMICAL OR NEW SOURCE OF BUTADIENE? • HOW SMALL BUSINESS CAN SERVE ITSELF AND BE SERVED BY RESEARCH • ESTIMATED SUPPLY AND REQUIREMENTS FOR SULPHURIC ACID • RUPTURE DIAPHRAGMS • DEVELOPMENTS IN PAINT AND VARNISH INDUSTRY • CHEMICAL SHOW REVIEWED

Modern chemical engineering equipment in electrolytic sodium chlorate plant in Oregon

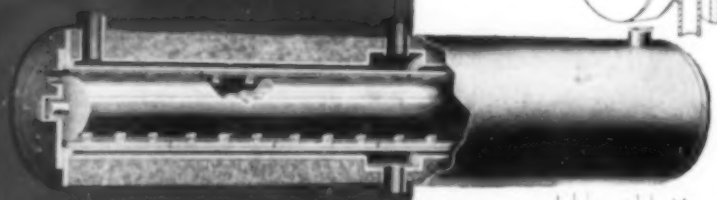


THE Votator

A GIRDLER PRODUCT

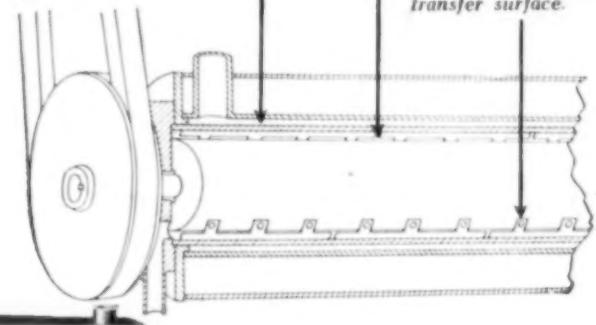
DOES BOTH JOBS BETTER!

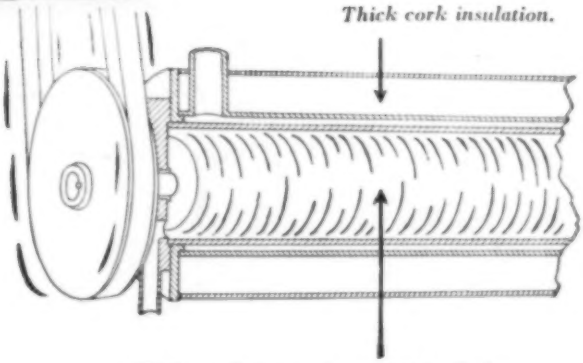
HEATING OR COOLING



PROCESSING

A standard Votator for chilling and plasticizing lard.





The cylinder shown above — the basic Votator mechanism for processing liquids and viscous materials — makes more efficient use of heating or cooling mediums. Improved processing can be accomplished in the continuous closed system Votator. Intimate contacting or emulsifying of reactants or ingredients can be obtained with the Votator system. Temperature and residence time are accurately controlled. If you will request and fill out our data questionnaire, we can give you specific answers as to what Votator will do for you.

Write The Girdler Corp., Votator Division, Louisville 1, Ky.

The Votator is also extremely efficient for many applications in the food industry, petroleum and industrial chemical fields — greases, waxes, photographic emulsions, paper and textile coatings, liquid resins, textile printing gums, preparations for the leather industry, etc.

Trade Mark Reg. U. S. Pat. Off.

if your traps were made of GLASS

. . . you'd see the difference

If you could look into steam traps and watch them operate you'd quickly see why so many plants are 100% Armstrong trapped. Armstrong built a trap with a glass body for exhibit purposes and many engineers have seen it work. They have seen that when steam enters the trap, the bucket floats and closes the valve absolutely steam tight. They have seen when condensate enters the trap the bucket sinks and opens the discharge valve. They have seen how particles of dirt and scale are swirled right through the trap without causing it to clog or stick or become inoperative. They have seen air bubble up through the bucket vent to collect at the top of the trap where it will be discharged when the valve opens.

They have seen the simplicity and quality of a trap that saves steam, increases machine temperatures and stays on the job. If you want to look into steam traps, write today for the Armstrong Steam Trap Book—36 pages of data, prices, capacity charts, tables and information on trouble shooting, trap installation practice, etc.

ARMSTRONG MACHINE WORKS
858 Maple Street • Three Rivers, Michigan

ARMSTRONG

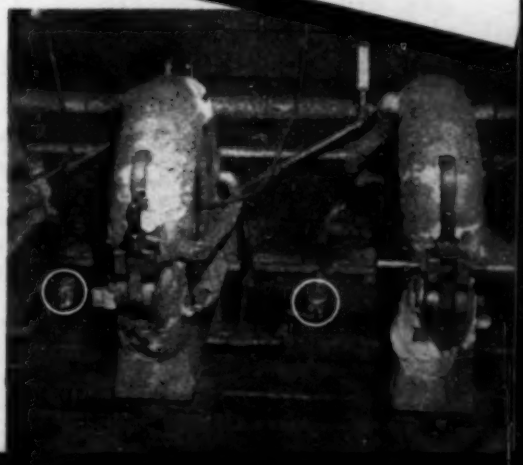
INVERTED BUCKET STEAM TRAPS

More Than a Million in Use! • *Sold through leading distributors and jobbers everywhere.*

• **CUTS FUEL COSTS 35%.** (File 4-43) Peerless Laundry Services, Ltd., Los Angeles, California, reduced fuel consumption approximately 35%, reduced heating up time by 30 minutes and reduced maintenance 8% by simply installing Armstrong Unit Trapping. (Normal boiler load is 50,000 lbs. per hour.)

• **HEATING UP TIME REDUCED 20%.** (File 1-43) When the boys in the production line want to get a machine going they don't like to stand around all day waiting for it to heat up. At Toronto Container Gair Company, Toronto, they solved this with 30 Armstrong Traps that reduced heating up time on a corrugator by 20%. P. S. Temperatures were more even and back pressure was reduced.

• **ANNUAL REPAIR COST $0.006 PER TRAP.** (File 4-41) After five years service at the Blind Floral Company, Pittsburgh, the repair cost on 165 Armstrong Traps had totaled fifty cents! You might not do as well, but this record needs no apologies even if the traps were handled with kid gloves and fed vitamins.



WATCHING WASHINGTON

R. S. McBRIDE, Editorial Consultant • PAUL WOOTON, Chief of McGraw-Hill Washington Bureau • MALCOLM BURTON, Washington Correspondent

Methanol and formaldehyde shortage cause concern. . . . Postwar education will be big business. . . . Necessity for technical men on war jobs to return to peacetime activities recognized. . . . Surplus property sales off to slow start. . . . No more molasses for alcohol. . . . A shortage of sulphuric acid tank cars faces industry. . . . Freight rates may be increased Jan. 1. . . . More carbon dioxide facilities badly needed. . . . Plentiful supply of metals forecast for 1945. . . . FDA announces new tolerance of fluorine as spray residue. . . . Tax changes on non-beverage alcohol causes complete upset of price indexes in chemical fields.

METHANOL AND FORMALDEHYDE

SPEED UP of the explosives program has taken some synthetic capacity away from methanol for ammonia manufacture. This has upset the WPB programs for supply of methanol and its derivative, formaldehyde. Certain plastics manufacturers have been seriously concerned lest they must cutback on both urea and phenolic types of plastics because of this scarcity.

If the annomia program is cut back heavily during the winter, as expected even before V-E Day if that date is long delayed, then resumption of methanol making should come quickly. In that event, the shortage of formaldehyde will be short lived. But it certainly is serious this fall.

ALKALI PROSPECTS

WPB EXECUTIVES predict that substantial increase in the export of caustic soda can go on for the fourth quarter of this year and probably during next year. This is possible because chlorine demands are relatively greater than caustic. Furthermore, Lend-Lease exports of caustic have shrunk and the deficit must be made up by new sales in Latin American markets.

Soda ash supply is also "satisfactory" but some difficulty is experienced in packaging. Increased export to Brazil of soda ash is expected soon.

SCARCE, MORE OR LESS

RECENT changes in the list of scarce chemicals published by WPB include the following major chemical changes: Chemicals newly listed in Group I "insufficient to satisfy war and essential industrial demands" are adipic acid, butyl alcohol, butyl acetate, carbon tetrachloride, chlorates and perchlorates, hydrofluoric acid (anhydrous), lactic acid, methyl amines and potassium permanganate. At the same time the following list of chemicals was announced as no longer sufficiently scarce to qualify for this Group I rating, namely, allyl alcohol, calcium carbonate, cobalt chemicals, dipentine, furfural, isopropyl acetate, methyl isobutyl ketone, styrene, thiourea and urea.

UNEMPLOYMENT FORECASTS

ALL FORECASTS of unemployment made in Washington appear to have political significance. Many of them are based on political motives. The estimates of those shortly unemployed range from 2 million to 11 million persons. Neither extreme seems probable. But it does appear correct that at least 20 million American workers will either have a new job or will be manufacturing goods for new sorts of customers within three or four months after V-E- Day. These estimates are of great importance because they underlie the psychology of both official planners and industrial executives. Estimates of chemical engineering prospects must take into account this wide range of guesses because they largely influence the planning of those whose decisions actually start enterprise moving, or delay the start.

A BIG "NEW BUSINESS"

POSTWAR education will be big business. As the plans for veterans shape up it is evident that several billion dollars will be spent in the five to seven years after V-E Day by Uncle Sam in helping in readjustment and education. Professional education will be a large part of this if the colleges of this country are able to set themselves up with facilities and faculties adequate for the job.

Some Washington agencies think that the various professional men of the country can do great things for their own professions if they will bring their influence to bear for high standards of technical work in this job with G. I. Joe. It is convincingly pointed out that mere spending of money is not going to produce high-grade engineers and scientists. Personnel managers of industrial enterprise can well indicate their hopes as to the type of men they will get from this educational effort. They can thus guide the universities and give competent faculties much needed moral support for something more than really getting the veterans money.

"CERTIFICATE OF NON-NECESSITY"

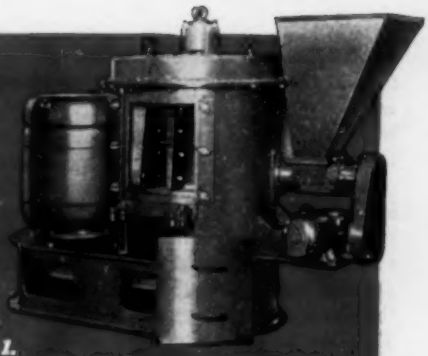
TO DETACH a technical man from a war job so that he may take up postwar activities has been a difficult thing. Military authorities have done all they could to slow down the separation of skilled technologists from their projects. But Washington at higher levels has recognized the necessity of letting a reasonable number of such men get promptly onto their postwar jobs. The executive order covering this matter as issued by the White House describes "determination of non-necessity" in the following language:

"An emergency facility shall be considered as having ceased to be necessary in the interest of national defense during the emergency period and a non-necessity certificate with respect thereto shall be promptly issued by the certifying authority upon proper application therefor where, in view of the condition, location and ownership of such emergency facility, the certifying authority has determined that no presently forseeable substantial need for such emergency facility exists in the interests of national defense."

TROUBLE AHEAD

POLICY of WPB in granting AAA ratings for maintenance, repair and operating supplies is tough, as has been found out by chemical producers who have asked for an up-rating of the AA-1, the highest that can be issued under P-89. The green light is being given only to plants producing direct war material—the stuff that is going right out onto the firing line. At this time chemical producers directly involved in the increasing ammunition program and in certain Navy programs that are just starting are those that are favored with the highest priority assistance.

Inquiry as to what relief can be expected



Available in sizes up to and including 3 horsepower in three different speed ranges—3 to 1, 6 to 1 and 9 to 1. Only with an all-metal drive can you secure the compactness, simplicity, flexibility and economy that are so advantageous today.

Infinitely variable speed may be secured to any R.P.M. within the range of the unit. The output speed is increased or decreased by variation of the position of the ring on the two driving and two driven cones.

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

Available in the vast number of types that make up the Master line including the flanged type as shown, also gearhead, unibrake, fan-cooled, explosion-proof, splash-proof, multi-speed, etc.

Save material and save space with the simple compact, integrally built Master Speedranger. The all-metal construction insures greatest possible durability and freedom from service interruptions.

for other chemical producers whose plants are in danger of closing through inability to secure repair parts, reveals that there is little hope at this time for assistance if the plants are engaged in production for civilian use. The high ratings which are necessary to secure such items as pumps require favorable action of the Special Rating Division before they can be issued. At that level, the policy remains unchanged. They are all out for military production.

ACTUAL SALES SMALL

SURPLUS property disposal by the government has not started promptly because it has taken a number of weeks for the President to review the new Congressional law and wishes, and to arrange for a new board to serve under this new law. Actual disposals in August, for example, were about $28,000,000. But most of the sales have been minor surpluses of industrial or consumers goods. No major plants have been sold.

CATALOG OF PLANTS

IN ANTICIPATION of the time when a great many government-owned industrial plants will be put on the market, information on all plants and sites owned by DPC is being made available for the benefit of potential purchasers in a briefalog. There are 879 DPC projects listed and 94 that are War Department owned. This, then, covers approximately one-half of the government-owned plants and sites that will eventually be put up for sale.

The fact that the present operator may have an option to purchase a plant should not discourage investigation. Many of these options will not be taken up because the terms are not as favorable as the purchaser might be able to get by negotiation.

HEAVY DUTY TIRES

EFFORTS to solve the problem of labor shortage in the manufacture of heavy duty tires reported in these columns last month has been successful to the extent that much of the needed labor has been recruited. The training program is under way. At the moment the bottleneck is a shortage of some tire-making facilities. This is a direct result of greatly expanded military requirements for certain sizes. The facility shortage does not mean factory space, but rather a shortage of machines here and there for the manufacture of the particular sizes of tires. By the end of the year these problems will be ironed out and tires will be coming off the production line in the required quantities.

DO IT NOW !

INDUSTRY is warned to file claims promptly for final settlement of terminated contracts for war material. At the time of going to press it was stated by high government officials that 70 percent of the settlements were waiting for claims to be filed. Fear is expressed in Washington that the organizations included in this 70 percent will finally get around to filing their claims at approximately the same time. Facilities of the armed services will be swamped if this happens.

A regulation on contract termination published by the Army and Navy in a joint effort is expected to be of assistance in breaking the log jam. This book will be the "Bible" of contract termination for the armed forces and manufacturers with whom the Army and Navy do business. By closely following instructions laid down in the new regulation much speedier settlements will result.

TREND TO PETROLEUM

MORE PETROLEUM products are being used in the production of synthetic rubber than was the case some months back. This trend is in accordance with the original plans for the synthetic rubber industry which called for a considerable amount of butadiene to be produced from petroleum products, butylene, butane and from the cracking of naphtha.

The flexibility of the high octane gasoline and synthetic rubber programs is evident in this trend. Some months ago the aviation gas program began to use butylene that was originally scheduled for the manufacture of butadiene. Production of aviation gasoline has now increased to the point where it is not necessary to take these materials from the synthetic rubber industry and for the first time the production of 100-octane gas is sufficient for both combat and training requirements. This will permit the petroleum refiners to start work on some of the super fuels.

The trend toward the basing of a greater amount of synthetic rubber production of petroleum will result (1) in the cheaper production of butadiene, (2) a saving in grain for alcohol, (3) a saving in sugar for alcohol and (4) will permit beverage producers to go back to their normal business. It will also have the effect of putting the synthetic rubber industry on a more stable basis for operation after the war.

SCOPE OF OPERATIONS

POLICY MATTERS in regard to commodities in international commerce are to be handled by the Commodities Division, according to the best available information. A staff of technical men at present only one or two for each major industry will act as liaison between the State Department and other government bureaus having technical men. This staff will assist in the determination of policy in such matters as trade agreements to secure tariff concessions for the export of U. S. surpluses. They will assist also in policy matters arising from international commodity agreements such as already exist in the case of wheat, coffee, and sugar, and that may possibly be made in the case of tin, cotton, rubber and copper.

MODUS OPERANDI

PROBLEMS of international commerce that must be solved by the government are to be handled by two committees. The lower committee which does the spade work is to be made up of representatives of seven agencies, Departments of State, Agriculture, Commerce and Interior, Tariff Commission, the Foreign Economic Administration and War Production Board. This committee makes the first recommendations which are sent to the higher committee for decision.

The Executive Committee on Foreign Economic Policy is the official name of the top committee which operates in the stratosphere where broad economic problems are handled, such as international labor policy and finance. Only six agencies are represented on the Executive Committee, Departments of State, Labor, Treasury, Agriculture, Commerce and Tariff Commission.

THE $80 QUESTION

IN THE AMBITIOUS expansion of the State Department are we watching the unfolding of a super economic organization to function in international trade with control to rest ultimately in the hands of Donald Nelson?

NO MORE MOLASSES

EASTERN ALCOHOL plants must convert to the use of grain when present stocks of molasses are exhausted. A short crop in Cuba and not enough tankers to ship the molasses early in the season is the unofficial explanation given by government officials who are reluctant to talk for publication on a subject with so much political dynamite.

The conversion to grain will cost the plants some production but the loss is not expected to hurt the rubber program. All the alcohol needed will be there when it is needed, according to WPB's Chemical Division.

Whether the argument that the potential sugar supply is ample for all uses, including alcohol, will make much headway with the officials who must make the final decision was not known at the time of going to press. Opinion was that if the molasses was available it would be used for the manufacture of alcohol. Apparently it will not be available.

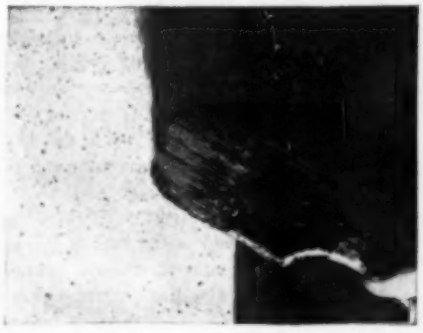
TANK CAR SHORTAGE

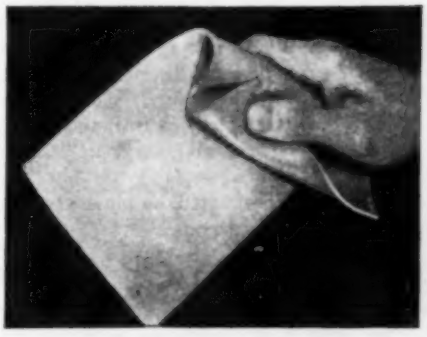
SHORTAGE of tank cars for the transportation of sulphuric acid will become an increasingly severe problem for the industry for the next six months. Reports from the office of the Chief of Ordnance are an indicated shortage of over 300 cars by the end of the year. This will increase to a shortage of from 700 to 800 new tank cars by March if the present industrial and military requirements are met.

The only relief in sight is through the conversion of cars from other service.

TYGON--*the corrosion-resistant Paint*

CHEMICALLY INERT · FLEXIBLE · TOUGH · NON-AGING





OF TOP importance in any chemical plant maintenance program are the steps taken to prevent corrosive deterioration of plant equipment and buildings.

Various corrosion-resistant materials are available, which when properly engineered will protect tanks, pumps, pipe, valves and other equipment from the corrosive attack of the specific chemicals they are designed to handle.

But the corrosive problems created by an atmosphere heavily loaded with mixed fumes, gases and moisture, and by condensation, frequently prove troublesome, costly and difficult of solution.

To solve this problem of protection against corrosive atmosphere, U. S. Stoneware engineers developed Tygon Paint. Tygon Paint is a liquid formulation of pure Tygon—the flexible, rubber-like material used to line acid tanks. Specially prepared Tygon sheets are liquefied by the addition of appropriate solvents. This liquid Tygon is then applied over properly prepared and primed surfaces just like an ordinary paint. The solvents quickly evaporate, leaving a tough, sturdy, durable, protective film of pure Tygon. This tough, non-aging, non-flammable, and non-toxic Tygon film provides lasting protection against almost all corrosive fumes. Not only are Tygon Paint films resistant to the attack of most acids and alkalis, but they are likewise unaffected by oil, gasoline, alcohols, fresh or salt water.

Tygon Paint films do not become excessively brittle at low temperatures nor soften at temperatures up to as high as 175°F. With special primers such as Tygon TP-109, temperatures as high as 200°F may be handled satisfactorily.

Unlike ordinary paints, Tygon will not oxidize and chemically deteriorate with age. Tygon Paint films will not craze, crack, check, chip or weather. Tygon Paint is easy to apply by spray gun or brush to almost any surface —metal, concrete, stone, wood. It air dries quickly, usually within an hour. The number of coats required depends on the anticipated severity of the attack.

Engineers like it, not only from a surface protection point of view, but from an appearance standpoint as well. Tygon Paints are available in a wide color range including white, black, gray, green, red, blue, aluminum and clear. The smooth surface does not wet readily, resists the accumulation of greasy fume scum, washes easily clean.

Would you like to try it? We'll be glad to send you, without charge, an ample sample for any tests you might care to make. Address your requests for samples to: Process Equipment Division, The U. S. Stoneware Company, Akron 9, Ohio.

Other Tygon formulations of interest to the chemical engineer:

TYGON SHEET STOCKS: For heavy duty tank service where corrosive and abrasive conditions are severe, use Tygon-lined steel tanks. A full 3/32" of sturdy Tygon sheet is applied to the steel shell by our exclusive process to form a continuous one-piece tank lining—effective and durable protection.

TYGON FLEXIBLE TUBING: Translucent or opaque, in diameters up to 1¼" O.D. and in varying wall thicknesses, for fluid or gas transmission. Has a flex life ten to twelve times that of rubber.

Complete descriptive details are available in Bulletin 1636, free, on request.

U. S. STONEWARE

AKRON, OHIO

OTHER U. S. STONEWARE PRODUCTS FOR MEN WHO HANDLE CORROSIVES

CHEMICAL STONEWARE: TANKS, POTS, JARS, LABORATORY SINKS, PIPE AND FITTINGS IN EITHER CERATHERM-500 HEAT-SHOCK RESISTANT OR STANDARD BODIES • CHEMICAL PORCELAIN • FILTER STONES • RASCHIG RINGS • ACID-PROOF BRICK AND CEMENT • RESILON LININGS • ACID-PUMPS

some of this is being done, but the transfer of tank cars to the handling of sulphuric acid is not possible in most cases since ICC requirements are for top unloaders.

HIGHER FREIGHT RATES?

FREIGHT RATES may be increased on January 1 for practically all industrial commodities by amounts ranging from 5c. per ton on coal up to 6 percent of the former base rate. However, the ruling authorizing such increases is subject to further action by ICC which has thus far suspended the increases.

The railroads are urging that they be given this higher freight income to offset anticipated decrease in traffic after V-E Day. Those seeking to prevent inflation oppose freight rate increases. Washington guesses that ICC will not permit the rise on January 1 unless much better evidence can be produced than has yet been offered as to the immediate need.

AIR TRANSPORT INDEX

GOODS CAN move by air most effectively if they represent a large dollar value per pound. Other factors encouraging air transport are perishability and fragility.

The Bureau of Foreign and Domestic Commerce has taken account of these facts in a series of mimeographed reports which discuss "Air Cargo Potentials" between the United States and each of the Latin American countries. Firms considering air transport of their goods either inbound or outbound, can secure copies of these statistical analyses by request to the Bureau at Washington 25, D. C.

MORE DRY-ICE

PRODUCERS of carbon dioxide for either cylinder or dry-ice distribution are urging WPB executives to grant further permission for new construction. Approximately 80,000 tons of new capacity per year was approved as early as September. The industry insists that at least 280,000 tons of additional capacity is urgently needed to satisfy merely "essential" needs. Major uses of carbon dioxide on which government and industry executives agree fairly well are for chemicals, beverages, ice cream, food and railway refrigeration. Industry spokesmen say that the government estimates should be revised strongly upward for medicinals, industrial fire extinguishers, and coal mining (explosives). Military requirements are being met so fully that allocation is not deemed necessary by the Advisory Committee.

BIG CUTBACK SURE

SPEED OF cutbacks will be greater than officially stated. It can be safely assumed that whenever V-E Day orders go out they will ask for curtailment by more than half of the total production of military goods.

Chemical and other raw materials producers can get from their customers soon a fair estimate of the cutback expected in each individual case. Army, Navy, and other contract officers are giving this information privately to each prime contractor. The cutback will not be uniform for individual companies making the same goods, nor the same for different kinds of goods. Special investigations as to 1945 requirements are, therefore, needed, company by company. A field guide for government officers dealing with these problems was prepared by the Office of War Information so that cutback announcements would be uniform and controlled. Executives can get guidance from it through their contracting officers when necessary.

MAGNESIUM DEMANDS

THE GOVERNMENT is more interested than anyone else in getting reliable estimates of magnesium requirements after the Japs are beaten. Some guesses from government offices are as low as 18 to 30 million lb. per year of magnesium metal for the early postwar years.

It is also reliably forecast that magnesium metal on hand at the end of the war will be several hundred million pounds. Obviously, therefore, the government will itself hold directly or indirectly enough magnesium to meet postwar demands for several years without any new production. Even the more radical critics of the industry do not think that the government should permit all new production to stop. But there are many theories and no significant conclusions yet available as to how the government can stimulate new methods of use, arrange for some continuance of manufacture, and still not hold tremendous unwanted surpluses for exceedingly long periods.

PLENTY OF METAL

FORECASTS of reconversion by industry are being made confidently on the assumption that there will be plenty of almost all kinds of metal for any desired new construction or modernization programs. Despite the fact that a number of metals are recorded as "strategic" in Congressional stockpiling rules, there is no ground for expecting shortage of these metals during 1945 despite the magnitude of Pacific fighting.

Chemical engineering designs and plans for postwar projects may assume adequate supplies of even the most special construction materials, almost without exception.

NEW FLUORINE TOLERANCE

THE FOOD and Drug Administration announced a new tolerance of 7 mg. of fluorine as spray residue per kilometer of apples and pears. This higher limit than previously allowed is based on present knowledge as to toxicity of fluorides in foods and beverages.

A WPB FOR CHINA

DONALD M. NELSON, former chairman of the War Production Board, was asked by President Roosevelt to return to China and organize a WPB in that country to increase the output of its war industries. Mr. Nelson's return was urged by Generalissimo Chiang Kai-shek.

Accompanying Mr. Nelson will be a deputy, a technical expert on alcohol production and a group of steel experts. Mr. Nelson's deputy will be Howard Coonley, a WPB executive and chairman of the Walworth Co. The alcohol expert will be Eugene M. Stallings, director of development, Jos. E. Seagram & Sons. The steel group will be headed by H. W. Graham, director of metallurgy and research, Jones & Laughlin Steel Corp. Others in the group are: Carl A. Bell of United Engineering and Foundry Co., Henrik Ovesen of Lukens Steel Co., Harry A. Strain of United States Steel Corp. and E. K. Waldschmidt of WPB.

ALCOHOL TAX DISTORTIONS

COMPLETE UPSET of normal price indexes in certain chemical fields has come about through changes in taxes on nonbeverage alcohol. When Congress raised the tax on undenatured alcohol, the price to drug and pharmaceutical users was largely increased. Somewhat later a drawback became effective reducing the net cost; but meantime the Department of Labor figures on drug and chemical prices became much distorted.

Bureau of Labor Statistics is now preparing to revise these index numbers. The cutback on drugs and pharmaceuticals will certainly be very large because in recent months both the tax effect has been exaggerated and too great weight has been given to alcohol. One proposal would cut the index number for these materials almost in half.

DDT UNDER CONSIDERATION

PENDING completion of agricultural research projects under way, federal entomologists do not recommend the war-developed insect killer for commercial agricultural use, WPB's DDT Producers and Arsenical Producers Industry Advisory Committees were told at a recent meeting.

WPB officials told the committees that production of DDT is limited because of expanding military programs calling for chlorine and benzene. Increased military requirements for DDT also make the chemical less available for any civilian needs. However, WPB officials expect that all military requests will continue to be satisfied, and that limited supplies will be available for agricultural experimentation. P. H. Groggins, chief of the Chemicals and Fertilizers Branch of the War Food Administration, reported that substantial quantities of DDT will be needed to continue development work.

INTERPRETATIONS

This installation covers orders, rules and regulations issued by the War Production Board and the Office of Price Administration during October, 1944. Copies of each item interpreted here may be obtained from the appropriate federal agency.

CONTROL OVER SOLVENTS

While official consideration has been given recently to the relocation of controls over Class A solvents, increased requirements for xylol in the aviation gasoline program have made it necessary to maintain the measures currently operative. Class B solvents likewise are in limited supply because of the rise in demand for toluol for aviation gasoline and high explosives. Hence the announcement that controls would be retained indefinitely. Class A solvents as defined in Order-M150, are generally known as xylene range aromatic solvents and Class B solvents as toluene range aromatic solvents.

CHLORINATED PARAFFIN

Effective Nov. 1, chlorinated paraffin was placed under the provisions of general chemicals order M-300. This puts the material under allocation for the first time. Used as a coating for textiles, requirements for chlorinated paraffin have expanded so rapidly that military authorities requested that it be placed under distribution control.

GLYCERINE LOADINGS

In an amendment to the glycerine price regulation, OPA has decreed that a carload lot of glycerine must weigh 36,000 lb. or more, net. Formerly a carload lot varied between 20,000 lb. and 50,000 lb. depending upon the carrier and the zone, representing the minimum quantity that would move at carload rates under applicable railroad tariffs.

ORDER M-300 AMENDED

To facilitate the handling of allocated materials during the reconversion period, WPB has amended Order M-300, the general chemicals order. It will now be possible to continue control over that part of chemical distribution that is essential for the war effort without governmental supervision over uses in the production of specified civilian items. The amendment applies only where the supply is adequate to permit the lifting of controls on allocated materials for specified civilian goods in cases where military requirements necessitate the continuance of allocation for war orders.

CONTROLS REMOVED

All government controls on the use of magnesium for civilian products have been removed through the revocation of Preference Order M-2-b. At the same time WPB issued Order M-2-c which provides that all restrictions on use of magnesium contained in other orders no longer apply. However, restrictions in other orders as to the quantity of an article that may be made or as to its size or type remain in effect.

Dichlorethyl ether which was placed under allocation last January is now in ample supply and has been freed from distribution control.

Cryolite no longer needs to be conserved as a safe reserve has been built up, aluminum requirements have been reduced, and productive capacity for a synthetic product has been expanded.

Lithium chemicals are going into military products in a smaller way and larger stocks have made it unnecessary to continue allocation control.

Cellulose acetate butyrate, urea and melamine molding powder used in plastics are free from allocations. They were the first materials to be affected by the amendment to Order M-300.

ADIPIC ACID CONTROL

Adipic acid has been transferred to the control of Order M-300 and under Schedule 55 the entire output is now allocated for military requirements with very few exceptions. Prior to the transfer, all requirements for nylon production were first supplied without the necessity for allocation. Only that part of adipic acid production which remained after nylon demands had been filled was subject to allocation. Purchasers are required to submit end-use certificates to suppliers who, in turn, must furnish Form 2947 to WPB for allocation requests.

FORMS FOR OILS AND FATS

New forms are being used in reporting to WFA, the July-Sept. quarterly totals covering the use of oils and fats in the manufacture of edible products, protective coatings, floor coverings, coated fabrics, and soap. Quota users of oils and fats under Food Orders 42, 42a, and 42b now are required to report their use directly to WFA. They formerly reported to the Bureau of the Census.

FIBER SHIPPING DRUMS

For greater working efficiency, the fiber shipping drum order, L-337, has been amended. The principal new provision calls for a one-time certification to the drum manufacturer that purchasers are familiar with terms of the order. Certifications are required by many WPB orders and serve to prevent misunderstandings. The amended order also permits inner containers for fiber drums for goods that require this added protection.

METAL NAPHTHENATES

Metal naphthenates are used for mildew-proofing of canvas, duck, rope, and webbing. Zinc naphthenates are allocated exclusively for military purposes. Lower copper content naphthenates are granted for essential civilian use in treating wood and textiles (principally fishing nets), while all naphthenates containing sufficient copper to meet military specifications are reserved for military needs. Because of increased military demands, consumers are now required to submit additional information with their allocation applications.

PRICE REGULATIONS

Inter-producer sales of lime or gypsum products may be made above their present ceiling prices provided the buying producer sells the product in the same form as purchased and the higher price is not reflected, directly or indirectly, in the resale price.

Gum rosin was placed under ceiling prices a few weeks ago but effective Oct. 11, the newly established ceilings were increased by 24c a 100 lb. This action was found necessary to maintain and encourage production necessary for the effective prosecution of the war.

Monohydrated copper sulphate has been subjected to a price revision through an increase in the ceiling which amounts to 25c a 100 lb. in the eastern territory. This is applicable only to sales in 200-lb. drums in lots of 36,000 lb. or more but the increased cost to retailers may also be passed along to consumers.

Limed calf trimmings and cheekings, when not treated with arsenic, have been removed from coverage of the regulation governing prices for hide glue stock. Evidence was submitted to prove that these products were used in making gelatin rather than as glue stock.

CHEMICAL
& Metallurgical
ENGINEERING

ESTABLISHED 1902 S. D. KIRKPATRICK, Editor

NOVEMBER, 1944

Research Moves Across the Tracks

RESEARCH, the change maker, is at work in new surroundings. In a stylish old suburb of Philadelphia the great $2.5 millions estate of the late Edward T. Stotesbury becomes the new Whitemarsh Research Laboratories of Penn Salt's expanding organization of investigators and trouble shooters. Near historic Morristown, in New Jersey, an estate once owned by the late Otto Kahn has been selected as the building site for Allied's centralized research department. Down in Virginia, near Charlottesville, the Institute of Textile Technology takes over a great southern mansion. Up on Red Mountain, above Birmingham, Ala., an old and famous home will soon house the newly formed Southern Research Institute. Similar changes are probably occuring elsewhere. Research, now that it has become so fashionable, has moved across the tracks. With this change comes a challenge.

What was it that led the former owners to abandon these luxurious quarters? High, almost confiscatory, taxes were certainly one good reason. Maintenance and upkeep, aggravated by the labor shortage, was another. Less easily recognized, but none the less important, has been the political and social revolution of the past 12 or 15 years. In this particular effect it has not differed greatly from what has happened elsewhere in the world—for example to those once great castles along the Rhine. Costly investments of the wealthy have been written down to such proportions that they can serve more practical, utilitarian purposes. In the long span of history this sort of distribution of wealth is probably as desirable as it is inevitable.

But what does it mean to the practical, hard-headed men and companies that are intent on making their research dollars pay out? No one can argue that these luxurious homes have not been bargain purchases, especially in these times when new construction is difficult, if not impossible. No one can argue that men and women cannot work better in nice surroundings, away from the noise and dirt of the factories. And, whatever privileges are gained through tax exemptions to non-profit foundations or are absorbed as necessary research expenses by prosperous corporations, these will help to offset high upkeep and overhead. Yet some of these added costs will always be with us and it will be largely up to research to pay for them.

Facing this problem practically and realistically, research directors and their sponsors must make certain that these new facilities are reasonably productive. They have not been bought in the expectation of quick profit, of course, nor can they be charged off permanently as show places and, therefore, part of the advertising budget. They must produce. If they fail or prove to be only fair-weather sailors, they will reflect not only on research, but also on the judgment and sincerity of corporation management. This test comes at a time when too many uninformed leaders and agitators in the halls of Congress and in the Department of Justice are telling the people that research is a luxury that patent monopolies deny to the smaller, poorer companies.

We all know that research is a process involving more than facilities and personnel. There must be teamwork and understanding, leadership and inspiration, as well as generous, sympathetic support. We believe that all this is possible, in fact is the motivating influence behind much of industry's present enthusiasm for research. These converted castles are really convincing evidence of a desire to put something called the spirit of research on a high and mighty pedestal. But behind the marble columns and bronze doors, someone will have to dig deeper and work harder to produce the wherewithal.

JOHN R. CALLAHAM *Assistant Editor, Chemical & Metallurgical Engineering*

BUTYLENE GLYCOL

Postwar Chemical or New Source for Butadiene?

In 1942, when the rubber situation became critical, attention was drawn to methods of producing butadiene from 2,3-butylene glycol, a product known to result from selective grain fermentation. Cooperative research, coordinated by the Northern Regional Research Laboratory, was undertaken by a number of organizations. The final process, demonstrated in pilot plant operations by Joseph E. Seagram & Sons, Inc., provides a technically sound method for producing high-purity butadiene for synthetic rubber and what appears to be an economical source of butylene glycol for potential postwar industrial uses.—*Editors*

BUTADIENE FROM BUTYLENE GLYCOL

NRRL—Seagram Process as Demonstrated in Pilot Plant

1. Acid hydrolysis of grain starch and fermentation of the hydrolysate with *Aerobacter aerogenes* to yield about 14.5 lb. of meso-2,3-butylene glycol per 56-lb. bushel of wheat.

2. Recovery of about 95 percent of the butylene glycol from fermented mash by vapor phase extraction (steam stripping).

3. Acetylation of 97 percent of the 2,3-butylene glycol to produce 2,3-butylene glycol diacetate.

4. Pyrolysis of 88 percent of the diacetate to 1,3-butadiene corresponding to 7.05 lb. butadiene per bushel of grain.

5. Over 99 percent recovery of acetic acid from pyrolysis for reuse in esterification; separation of methyl vinyl carbinol acetate and methyl ethyl ketone acetate for re-pyrolysis to butadiene.

6. Recovery of the following byproducts for each bushel of grain mashed: 0.83 lb. of ethyl alcohol, 18 lb. of dried grain feed, 1.05 lb. of methyl ethyl ketone.

FIRST WORK in this country on 2,3-butylene glycol fermentation was done by Iowa State University in the late twenties. The study, mostly on culture selection and laboratory fermentation, was taken up and continued by the Northern Regional Research Laboratory in 1941. In April, 1942, when the synthetic rubber situation in this country was critical, directors of the NRRL called a conference and invited representatives of industry to investigate the butylene glycol process for producing butadiene.

Some 24 representatives of industry and research organizations attended and agreed to a cooperative study to be focused at the NRRL, which was to circulate all findings. Pilot plant work based on research findings was later undertaken by the NRRL, Joseph E. Seagram & Sons, Inc., Schenley Research Institute and the Canadian Research Council. Schenley operations, principally on fermentation and glycol recovery, had to be discontinued since proper equipment could not be obtained.

The Canadian Research Council has concentrated on levo-butylene glycol from starch fermentation rather than meso-glycol from carbohydrate fermentation, upon which effort has been focused in this country. Incidentally, levo-glycol is a good substitute for ethylene glycol antifreeze; the meso form is worthless for this purpose.

Only other organizations to continue development of the process were the NRRL and Seagram. Laboratory and pilot plant work at the NRRL was largely concentrated on glycol recovery, esterification and pyrolysis. Here it might be said that frequently there is some difficulty in distinguishing just which work originated with the NRRL and which with Seagram—so complete has been the cooperation and pooling of information between these two organizations. There is, however, plenty of red-meat credit for both; final success of the project can best be shared on an equal basis.

Construction of the Seagram pilot plant in Louisville began in July, 1942; operations extended from June, 1943, to June of this year. Equipment for studying all the principal operations in the process was set up and demonstrated. Altogether, erection and operation of this pilot plant has cost Seagram in the neighborhood of $750,000 with no expense to the government.

HERE'S THE PROCESS

Briefly, the final process as demonstrated in the Seagram pilot plant consists of five operations: (1) Acid hydrolysis of grain starch and fermentation of this by *Aerobacter aerogenes* to produce meso-2,3-butylene glycol; (2) recovery and concentration of the glycol; (3) esterification of the glycol to diacetate; (4) pyrolysis of diacetate

to 1,3-butadiene; (5) recovery of acetic acid, methyl ethyl ketone and grain proteins.

Description of the process as given herein is based on Seagram pilot plant operations. Results have, in general, been interpreted from the viewpoint of the process as it would probably be applied on a commercial scale.

Wheat or corn from storage, after passing through a continuous feeder, is ground to 60–75 percent on 12, 16 and 20-mesh screens in a 3-high roller mill. It then drops into a steel slurry tank where water and steam introduced continuously maintain a concentration of 33.5 gal. of mash per bushel of grain. Temperature of the slurry is held at about 150 deg. F.

Slurried mash is pumped into a steel Hastelloy-lined cooking tube. Concentrated sulphuric acid, added just before the slurry enters the tube, maintains the mash acidity at 0.26*N* in the cooker. Acidified mash is heated by means of a steam jet heater to 325 deg. F. for three minutes. By this operation, 95–96 percent of the starch and pentosans in the grain are converted into fermentable sugars, giving a concentration of 10–10.5 percent. Discharged mash is neutralized with calcium carbonate and cooled in a steel flash chamber to 240 deg. F.

Calcium carbonate as a 10 percent slurry is pumped continuously into a sterilizing tube and heated by a steam jet heater to 240 deg. F. for 6–7 minutes. Sterilized slurry is introduced into acid mash discharging from the cooker so as to give a pH of 5 in the neutralized mash.

Saccharified mash from the flash chamber is cooled in a tubular heat exchanger, after which ammonia solution amounting to about 1 percent by volume is added. This increases the pH to 6.1–6.2. Mash then flows into the closed steel fermenters, previously sterilized with steam at 240 deg. F. Five percent by volume of inoculum is added and sterilized air is turned on. Sterile antifoam is then added.

AEROGENES AT WORK

The mash is agitated during the entire 36-hr. fermentation period and is aerated for approximately twenty-four hours; aeration is stopped when the rate of sugar drop becomes 0.1 percent per hour or less. Temperature of the fermenter is automatically controlled at 88–90 deg. F. by internal cooling coils. Final pH of the fermented mash is 5.3 and the concentration is about 44 gal. per bu.

Best strain of *A. aerogenes* has been found to be No. 766, a culture obtained from the University of Wisconsin the value of which was discovered early this year by Seagram bacteriologists. With No. 766, the primary non-volatile product is 2,3-butylene glycol, production of which approaches the theoretical yield of 50 percent by weight of fermented sugar. A small quantity of ethyl alcohol is produced. This organism, a bacterium and not a yeast, is able to ferment glucose, maltose, sucrose, and the pentoses; does not ferment starch.

In pilot plant operations, compressed air was sterilized by passing it through chambers packed with non-absorbent cotton. However, a new method was employed which consisted of compressing the air to 90 lb. per sq.in. gage in carbon ring piston-type compressors. The heat of compression raises the air to 400 deg. F. and thus sterilizes it.

Aeration with agitation produces a higher yield than aeration alone. Proper agitation also reduces air requirements from 6.6 to about 3.0 cu.ft. per min. per 1,000 gal. of mash. Under these conditions a yield of about 14.5 lb. of glycol per 56-lb. bushel can be expected commercially although yields up to 15.5 lb. have been obtained in the pilot plant.

GETTING OUT THE GLYCOL

Because of the high boiling point of glycol, the problem of recovery is mainly one of separating solids in the beer from the glycol. A number of recovery methods were tried out, including spray drying, alcohol precipitation, solvent drying with trichlorethylene, drum drying, kerosene distillation, solvent extraction, and finally vapor phase extraction (steam stripping). Of these, vapor phase extraction by steam stripping, developed largely by personnel of the NRRL, was adopted as most promising.

The distribution coefficient of butylene glycol between the liquid and the vapor phase favors the liquid phase. Thus, at 214 deg. F. a 14 percent solution of glycol is in equilibrium with vapor containing 1.3 percent glycol. As the temperature increases the distribution equilibrium shifts and becomes more favorable: at 302 deg. F. a 14 percent solution of glycol is in equilibrium with 3.5 percent glycol vapor.

It is necessary to use a considerably greater quantity of steam than feed; for practical purposes this should be about 5–6 lb. of steam per lb. of feed. In order to make the process economical, it is necessary to recycle the solvent (steam). Purification and recycling is accomplished by scrubbing the vapors leaving the top of the extractor with water in a countercurrent column. This transfers the glycol into an aqueous solution free of grain solids and produces a purified steam to make up for pressure drop.

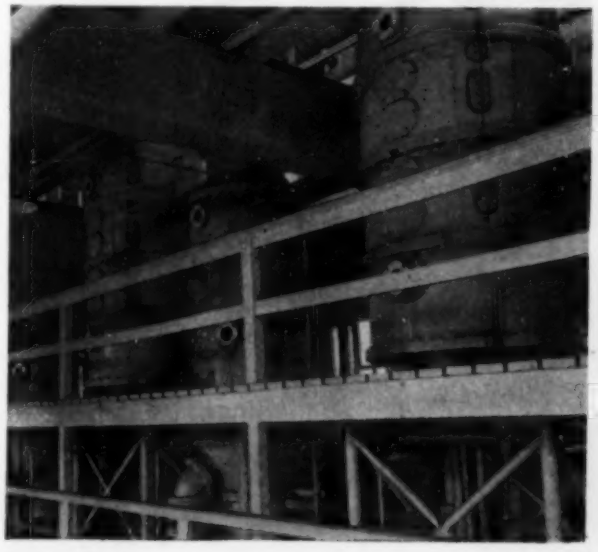
Pyrolyzers in which the diacetate was decomposed into pure butadience gas

Beer from the fermenters is fed to a quadruple effect evaporator on each effect of which is mounted a bubble cap column. Condensate from the steam chest of the third effect, containing about 0.92 percent alcohol, is fed to the alcohol rectifying column. Approximately 96 percent of the alcohol in the beer is recovered as 190-proof product.

Beer feed, which contains about 4 percent glycol, 7 percent solids and 0.25 percent alcohol, is concentrated in the evaporators to about 15 percent glycol and 25 percent solids. The concentrated sirup is pumped through tubular heat exchangers and raised to 300 deg. F. before being fed to the top of the steam stripper.

Stillage from the base of the stripping

Some of the evaporators used in the glycol pilot plant



Estimated Requirements and By-products of a Butylene Glycol-Butadiene Plant*

Materials Requirements	Per 100 lb. Butadiene
Grain, bu.	14.37
Acetic anhydride, lb.	11.71
Ammonia, lb.	402.0
Calcium carbonate, lb.	681.0
Sulphuric acid, lb.	518.0
Antifoam, lb.	2.15
Butadiene inhibitor, lb.	0.05
Caustic soda, lb.	7.59
Utilities Requirements	
Steam, M lb.	6.23
Water, M gal.	16.18
Electric power, kwh.	103.8
Fuel oil, gal.	4.23
Byproduct Materials	
Dried grain feed, tons.	0.176
Ethyl alcohol, 190-proof gal.	1.494
Methyl ethyl ketone, lb.	15.97

* Based on a plant having an annual capacity of 10,000 tons of butadiene with yields as given in the process summary contained in this article.

column is blown into an atmospheric flash chamber and goes to the stripped sirup tank before being fed to the grain recovery system. Here the sirup is dried to a moisture content of about 6 percent on cast iron atmospheric double-drum dryers.

This feed compares favorably with a product obtained from grain alcohol fermentation. It contains about 28 percent protein, is high in riboflavin and nicotinic acid. The material could be used to greatest advantage as a vitamin supplement in poultry and cattle feeds.

Vapors from the top of the stripping column pass into the base of the scrubbing plate columns. Water is fed to the top as reflux. Glycol-free vapors pass out of the top of the scrubber, a dilute glycol solution from the bottom.

Solution containing about 10 percent glycol is withdrawn from the base of the scrubbing column and fed through a flash chamber to a triple effect evaporator, each effect of which is fitted with a column for concentration to 70 percent glycol. Water is refluxed to the top plate to prevent glycol from boiling out.

Crude glycol is fed to a single effect evaporator, the vapors from which pass into a bubble cap rectifying column. As material in the evaporator body is boiled, vapors containing glycol pass into the rectifying column. Water reflux on the concentrator prevents glycol contained in the evaporator vapors from passing out of the system. The glycol is concentrated in the base of the column.

Dry glycol from the base of the column is fed to the glycol still, consisting of a vapor head and a calandria with a steam ejector pulling a vacuum, and undergoes simple distillation. Purified glycol, containing about 1 percent water, is sent to storage.

Material is withdrawn continuously from the concentrating evaporator body and from the glycol still at such a rate as to maintain a 10 percent solids concentration in both units. Draw-off is fed to the steam stripping columns, sirup from which is pumped to the dried grain recovery system.

NO EASY ESTERIFICATION

Initial studies on conversion of glycol to butadiene were directed toward catalytic dehydration of the glycol. Some 70 catalysts were studies, but conversion to butadiene in one pass seldom surpassed 20 percent. Main product of the reaction appeared to be methyl ethyl ketone.

As these studies did not indicate commercial feasibility, the production of butadiene by pyrolysis of butylene glycol diacetate was investigated. After a year and a half of concentrated effort on the part of the Northern Regional Research Laboratory and the Seagram Laboratory, a commercially feasible process was developed and demonstrated.

Butadiene scrubbing tower used in the Seagram pilot plant demonstration at Louisville

Problems involved in continuously esterifying glycol are quite different from those in the esterification of simple alcohols. In the most common continuous esterification processes the product forms a low-boiling water azeotrope and can be continuously distilled from the system. Glycol diacetate, however, is the highest boiling component in this esterification mixture.

Esterification is conducted in a conventional stainless steel bubble cap column heated by means of a calandria. The column contains 21 reaction plates below the glycol feed point and 5 plates above. Sulphuric acid catalyst diluted in the approximate ratio of 1 lb. of sulphuric acid to 10 lb. of acetic acid is pumped into the stream at a point just before the glycol enters the column. Temperature of the feed plate is approximately 245 deg. F.

Glycol and catalyst travel down the column, while excess acetic acid and a small amount of acetic anhydride are fed into the calandria recirculating line, where the temperature is about 330 deg. F. Intimate contact of glycol and acetic acid (in a molar ratio of 1:4) in the presence of the catalyst results in the formation of glycol diacetate. Acetic anhydride reacts with any water in the base of the column to form acetic acid, while the addition of anhydride at this point drives the reaction to completion and makes up acetic acid losses in the system. One side reaction which takes place is the formation of methyl ethyl ketone by partial dehydration of glycol in the presence of sulphuric acid.

A mixture of about 80 percent diacetate, 0.6 percent sulphuric acid and 19 percent acetic acid is withdrawn from the base of the esterification column. A mixture of 75 percent acetic acid and a small amount of MEK passes out as vapor into the middle of the acetic acid dehydrator. This is a stainless steel bubble cap rectifying column employing butyl acetate as the water entrainer.

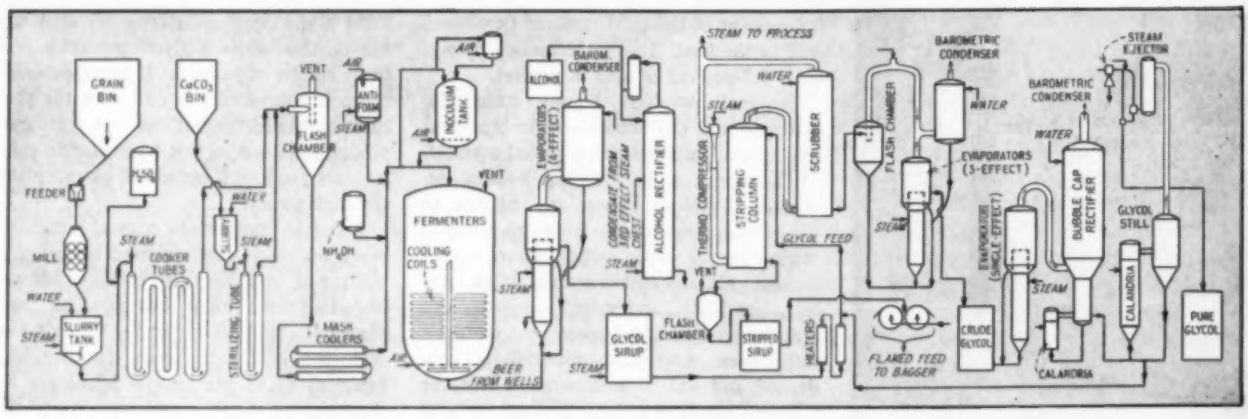
Dry acetic of about 99.7 percent is withdrawn from the base of the column while overhead, consisting of butyl acetate –water azeotrope and MEK, is condensed and fed to a decanter. The top layer from this is essentially butyl acetate and MEK, the bottom layer mostly water.

A portion of the water layer is fed to the bubble cap stripping column where butyl acetate is stripped out with steam and returned to the decanter. The oil layer from the decanter is split into two streams. The major portion is returned to the dehydrating column as reflux and the rest, consisting of about 25 percent MEK, butyl acetate and a small amount of water is fed to the MEK column.

This is a copper bubble cap rectifier heated with a calandria. Water azeotrope of 90–93 percent MEK is withdrawn from the top, condensed and fed to the storage. Butyl acetate is withdrawn from the bottom and returned as reflux to the acetic acid dehydrator.

Diacetate-catalyst-acetic acid mixture from the base of the esterification column is fed to the acetic acid stripper, which is of the bubble cap type. Dry acetic acid is withdrawn from the top and returned to storage.

Diacetate-catalyst mixture (about 93 percent diacetate, 6 percent acetic acid



Essential steps in the NRRL-Seagram process for production and purification of 2,3-butylene glycol are here shown

and 0.7 percent sulphuric acid) is withdrawn from the base of the column and fed to the diacetate still. This consists of a vaporizer and head operated under a high vacuum. Diacetate and acetic acid are flashed out of the feed, condensed and sent to the stainless steel diacetate storage tank. Draw-off from the still is regulated so as to maintain a concentration of 20 percent sulphuric acid and 5 percent acetic acid in the still. The draw-off is sent to settling tanks.

PYROLYSIS TO BUTADIENE

Diacetate produced by esterification is pumped from storage into the diacetate vaporizer and converter. This consists of an oil-fired furnace with a bank of stainless steel tubes in series. The feed consists of about 94 percent diacetate and 6 percent acetic acid. Feed rate and furnace temperature are so regulated that vapor contact time in the converter is approximately one second and temperature of the vapors leaving is 1,100 deg. F.

Diacetate undergoes pyrolytic decomposition to form a mixture of 24 percent butadiene, 60 percent acetic acid, 4 percent methyl vinyl carbinol acetate, 3 percent MEK acetate, 1.5 percent methyl acetyl acetone, together with MEK, noncondensible gases and hydrocarbons.

This mixture of hot gases passes into a quench chamber and is cooled to 195 deg. F. with a spray of cold pyrolysis liquors. Gas leaving the quench chamber, consisting of low-boiling materials, passes to the cooler system, which consists of two tubular heat exchangers connected in series. Gas is discharged from the cooler at 45 deg. F. and goes into the base of the butadiene washing column.

This is a ring-packed column which removes traces of high-boiling materials from the butadiene. Water is fed at the top and gases being washed pass countercurrent to the water flow. Water from the base is fed to the water stripping column, a perforated plate still heated with live steam. Any butadiene in the feed is stripped out and passes through the vent into the gas coolers.

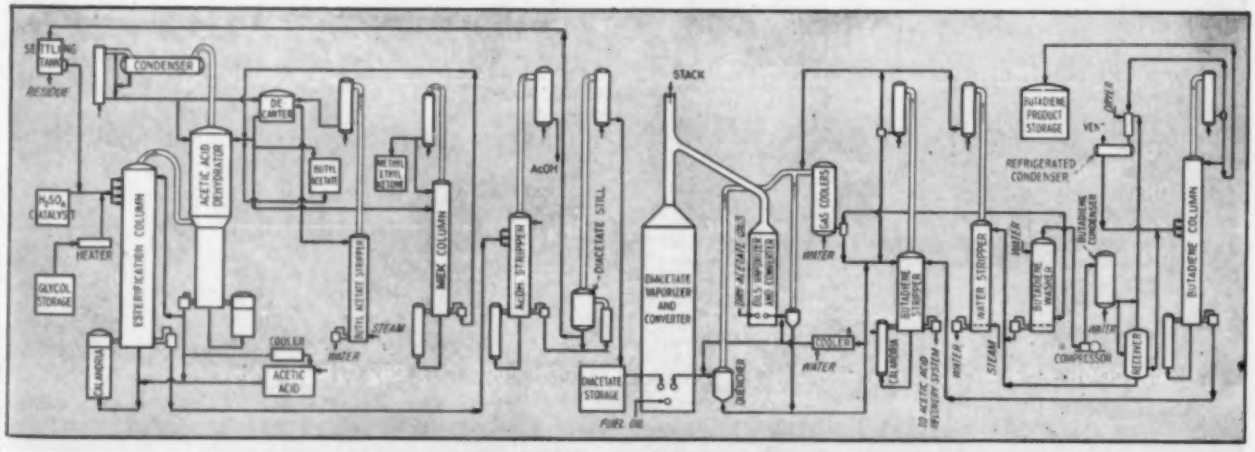
Washed butadiene gas passes into a tubular heat exchange type condenser and compressor, where it is condensed at 50 lb. per sq.in. gage. Butadiene is pumped from the receiver to the rectifying system, which consists of bubble cap columns heated with calandrias and operated under 65 lb. absolute. Low-boiling impurities in the butadiene are withdrawn from the top of the first column; bottoms are fed into the second column where high-boiling impurities are removed.

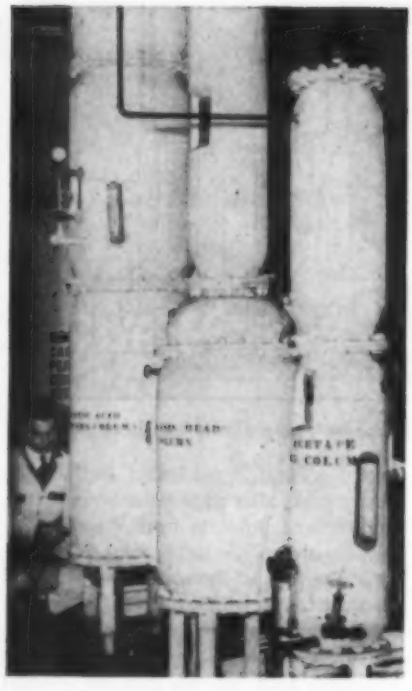
Purified butadiene from the top of the second column is condensed and sent to storage tanks after addition of an inhibitor. Revolatilized products from diacetate pyrolysis analyze 99.5–100 percent butadiene, while the product from pyrolysis of mixed unsaturated acetates averages 88–90 percent butadiene under process conditions. Butadiene produced in this pilot plant, stabilized with an inhibitor to prevent polymerization, has proved satisfactory in making experimental batches of synthetic rubber.

Pyrolysis liquors from the quench chamber and gas coolers are fed to the butadiene stripping column, which is of the bubble cap type heated with a calandria. Butadiene passes into the gas coolers, while liquor from the base of the column is fed to the oil stripper in the acetic acid recovery system.

The oils vaporizer and converter is fed with dry unsaturated acetates from the oil rectifying column in the acetic recovery system. This unit is similar to the diacetate vaporizer and converter. Hot gases from the oils converter are quenched with cold pyrolysis liquors; gases from the quench chamber are fed to coolers and handled along with gases from the diacetate converter. Products of this secondary pyrolysis consist of about 28 percent butadiene, 34 percent acetic acid and small amounts of unsaturated acetates.

Glycol is esterified to the diacetate which is pyrolyzed to butadiene. Acetic acid recovery system is not shown





Pilot plant acetic acid column set-up

On the basis of pilot plant observations, a one-pass pyrolysis at 1,103 deg. F. (with a contact time of 0.6 sec.) of the unsaturated acetate mixture from the stripping operation, followed by one recycle of the liquors, gave the best yield of butadiene without serious loss of acetic acid or excessive non-condensible gas formation. Acetic acid recoveries were 99, 95 and 88 percent of the first, second and third passes, respectively. In no case was is possible to reduce the formation of non-butadiene byproducts below 10–12 percent. The process has therefore been drawn up to show an 88 percent conversion of diacetate to butadiene.

Other than handling and mechanical losses, acetic acid is lost principally in the pyrolysis operations. In the primary pyrolysis, the loss of acetic acid is approximately 0.2 percent of the total free and combined acid in the feed. Loss in secondary pyrolysis is 0.2 percent of acid in process.

Stripped pyrolysis liquors from the diacetate and oils converters are separated into several fractions: unsaturated acetates, MEK, acetic acid, and high-boiling impurities. Pyrolysis liquors are fed first to the oil stripping column in which water is carried in the upper section as an oil entrainer. Unsaturated acetates, MEK acetate, free MEK, and volatile hydrocarbons are removed in the vapors by azeotropic distillation. Overhead material is condensed and fed to a decanter where the oils and water separate. The oil layer is fed to the MEK column.

Overhead from the column, made up of the azeotropic mixture of MEK and water, is condensed. Part is returned as reflux and the rest fed to the MEK storage. Oils, free of MEK, are discharged from the base and fed to the oil drying column.

This dryer is operated at a base temperature of 248 deg. F. Overhead, containing approximately 25 percent water, is condensed and fed to a decanter of which the oil layer is returned as reflux and the water layer is fed to the oil stripper as reflux. Dry oils are discharged from the base and fed to the oil rectifying column.

The oil rectifier is operated at a base temperature of 257 deg. F. and a top temperature of 237 deg. F. Unsaturated acetates are separated from MEK acetate and other impurities by fractionation.

POSSIBLE COMMERCIALIZATION

When Seagram pilot plant operations were completed this June, the Vulcan Copper & Supply Co. was asked by government officials to make an engineering report on the process and to submit estimates on a commercial plant to the Office of the Rubber Director. This has been done and the study has been reported upon by Dr. E. R. Gilliland of the Rubber Division of WPB.

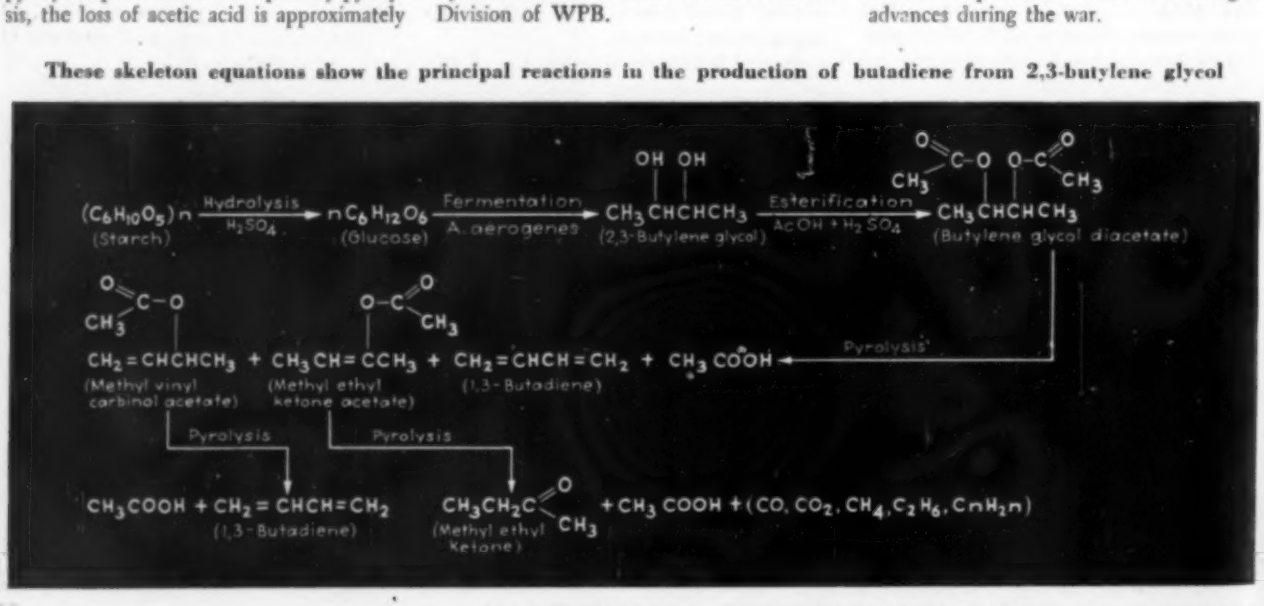
As a source of butadiene for synthetic rubber, this butylene glycol process is relatively simple and direct. It could probably compete successfully in cost with the present alcohol process, but not with petroleum processes. However, this fermentation process does produce a butadiene of exceptionally high purity.

Estimated production costs of butadiene, based on yields demonstrated in the pilot plant and including depreciation but not including investment charge, have been placed at about $0.35 per lb. Of this total cost, the charge for grain (at the high figure of $1.53 per bu.) is $0.22 per lb., depreciation $0.03, and operating cost about $0.10 per lb. These costs are based on a complete commercial plant for producing 10,000 tons of butadiene per year by this process. Estimated expenditures for such a plant, including buildings, land, utilities, yard facilities and feed recovery equipment, have been placed at $6,200,000. Of this, some $3,700,000 represents process equipment.

There is a distinct possibility that after the war the A. aerogenes fermentation might develop into a commercial source of meso-2,3-butylene glycol: (1) Potential industrial uses, although not yet intensively explored, appear promising enough to warrant further investigation; (2) this glycol can substitute for ethylene and other glycols in many applications, although not as an antifreeze agent; (3) cost of the glycol should not be high, since in general it can be made for approximately the same figure as industrial alcohol by corn or wheat fermentation. Cost of the grain will probably be the determining factor.

Regardless of whether the process eventually furnishes butadiene for synthetic rubber or butylene glycol as a chemical of commerce, the whole cooperative project remains as a heartening example of the government-industry-research organization teamwork that has contributed so much to American production and technological advances during the war.

These skeleton equations show the principal reactions in the production of butadiene from 2,3-butylene glycol



How Cheap Are Cheap Raw Materials?

FRED C. BOWMAN
Director of Research, A. R. Maas Chemical Co., South Gate, Calif.

Is the chemical industry penny-wise and dollar-foolish in its scramble for raw materials whose only virtue is cheapness? Cheap material is nearly always low-grade material, and low-grade material involves extra transportation, extra processing, extra handling, and extra equipment. It is not hard to recall numerous instances where the chemical industry has saved pennies on raw materials and spent dollars on the extras.

The finest example of cheap raw materials which the industry can show is the group of manufacturing processes loosely known as "heavy chemicals." Praise without limit is due the chemical engineers who developed them. Spanish pyrites was originally imported to yield sulphur dioxide and "cinder." The latter was desulphurized if conditions warranted and smelted for its content of copper. The sulphur dioxide went into sulphuric acid which was retorted with Chilean saltpeter to yield nitric acid and niter cake. The cake was furnaced with salt to yield muriatic acid and salt cake. The latter was furnaced with coal and lime and leached and crystallized to obtain sal soda, and final furnacing gave soda ash. Here every byproduct is the raw material for another process and so costs little or nothing. But pyrites contained only 40 to 50 percent of sulphur and required a much larger roasting plant and gave only a 7 percent very dirty gas, where it is possible to obtain at least 12 from sulphur. If the sulphuric acid were made by the contact process, a very large and elaborate gas purification plant was needed. The saltpeter formerly available was just good enough for fertilizer and gave a low-grade unstable nitric acid contaminated with both chloride and iodine. The muriatic acid was contaminated with nitric, and finally the soda ash was low in strength and high in impurities.

Thus it is not strange that this beautifully coordinated group of processes has been losing ground to rivals that are not dependent on each other and that demand —and get—almost chemical purity in their raw materials.

Phosphoric acid and its derivatives offer another example of the competing theories. The older plan was to leach phosphate rock with dilute sulphuric acid, separate by settling, concentrate to remove the rest of the calcium impurity, dilute again, neutralize to disodium phosphate, filter, add caustic soda to make trisodium phosphate, concentrate, crystallize, centrifuge and dry. This method yields an impure phosphoric acid fit for fertilizer use but not much else. The disodium phosphate made from it is fit for water softening but not for food or drugs. Likewise, the trisodium phosphate was fit only for detergent and softening purposes. This method is now in economic conflict with the manufacture from phosphorus which is burned to yield any strength of phosphoric acid desired and of a purity fit for almost any purpose. The acid is neutralized with soda ash and caustic soda to yield anhydrous disodium and trisodium phosphates of the highest purity. There is no settling, no filtration, no crystallization or centrifuging. Yields are nearly 15 percent better. There are no byproducts and the three products are pure enough to be suitable for many uses from which their older rivals are barred.

If itemized costs of these competing processes were available, which they are not, they would probably show that the concealed costs of having oversized plants, often in the wrong locations, of greater labor and repairs and of carrying oversized inventories would outweigh the greater costs of purer raw materials.

Multiwall Paper Bags for Packaging Rosin

Rosin is now one of more than 300 products packed in heavy-duty multiwall paper bags. The packaging of this material in paper was extremely difficult because a bag had to be designed which would prevent the hot rosin from penetrating the paper and the needle holes at the end of the bag. Nelio Resin Processing Co., Jacksonville, Fla., in cooperation with St. Regis Paper Co., a leading manufacturer of heavy-duty multiwall paper bags, developed a satisfactory container for rosin.

The bag designed for this operation is sewn on both the top and bottom except for a small opening which is used for inserting a 2 or 2.5-in. spout through which the hot rosin is poured into the bag at about 300 deg. F. The inside ply or bag is specially constructed so the hot rosin will not penetrate the paper.

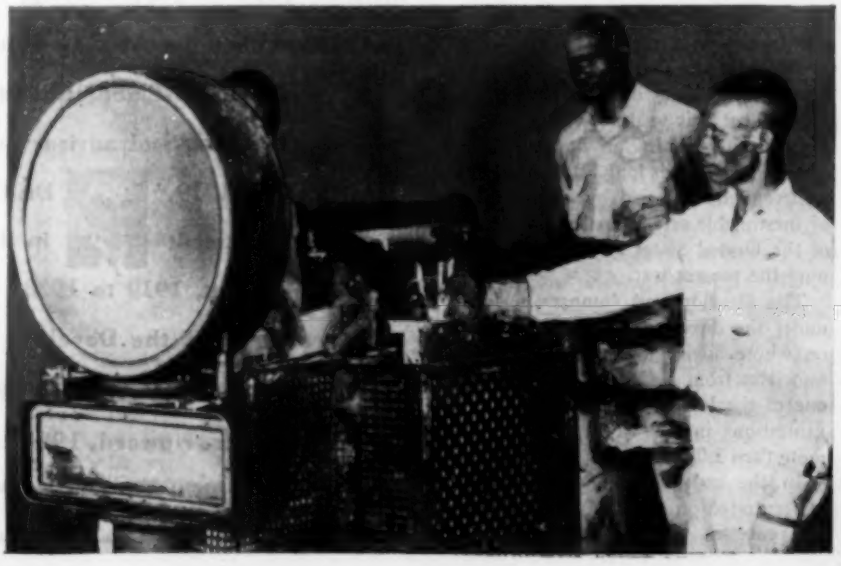
First the bag is placed in a form-cage or rack suspended on a scale. The spout is then inserted and the hot rosin forced into the bag. As soon as the scale registers 100 lb., the flow of the hot rosin is stopped and the open corner of the bag is stapled closed. The rack is then lowered to a horizontal position and the side plate, which now becomes the bottom plate, holds the jelly-like bag of rosin. The filled container is then transferred to steel cooling racks. The rosin requires about 24 hr. to solidify.

Prior to the adoption of the multiwall paper bag for packing rosin, the Nelio Resin Processing Co. was using a 29-gage galvanized steel drum which would hold a net content of 520 lb. The steel drum is still used by certain consumers who have no facilities for indoor storage.

From a producers' standpoint, the multiwall paper bag has proven to be an efficient and economical way of packaging and shipping this product. The heavy-duty multiwall paper bag has become extremely popular from a consumers' standpoint because it keeps the rosin clean, protects it from any contamination, is easily handled and stored and can be opened by merely stripping off the paper.

Postwar outlook for the multiwall paper bag as a package for rosin is extremely favorable.

Packaging hot rosin in specially developed multiwall paper bags



EDITORIAL STAFF REPORT

SILVER ANNIVERSARY

Forum on Future of Industrial Research

The successful record of Standard Oil Development Co. for the past quarter century is typical of the trend of research in the nation. But as a new period opens for that company and for the whole world those concerned with research are faced with many serious problems. These problems formed the basis of a discussion by leaders in industry, in government, and in education at a forum commemorating the Development company's 25th anniversary.—*Editors*

WITH JUSTIFIABLE satisfaction and pride the Standard Oil Development Co. celebrated its silver anniversary on October 5 in New York with an all-day forum on the future of industrial research in which many of the industrial leaders of the nation took part.

At the close of the first World War the parent company, the Standard Oil Co. (N. J.), planned a broad program of scientific advancement, undertaking to establish for the first time a complete, integrated, industrial development organization. That this venture with a new type of research organization has been a success is proved by its long list of outstanding achievements crowned by several that are of inestimable service to the armed forces of the United States and its allies in winning the present war.

The Development company has grown under the direction of Frank A. Howard, on whose advice it was formed, and his associates from a staff of only 30 men to one of the leading petroleum research organizations in the world with a staff of more than 2,000.

In the early days most attention was concentrated on the improvement of existing processes. Important economies were

WHO'S WHO IN HISTORY OF STANDARD OIL DEVELOPMENT CO.

E. M. CLARK: President of Standard Oil Development Company from 1927 to 1933. Closely connected with the development of the high-pressure hydrogenation process.

CARLETON ELLIS: Inventor and consultant to the Development company. Holder of about 750 patents.

R. T. HASLAM: Pioneer in hydrogenation, and general manager of the Development company, 1927-1933.

F. A. HOWARD: President of the Development company, 1922-1927 and since 1933. Manager of the old development department from its formation in 1919 to 1922.

Dr. C. A. KRAUS: As consultant to the Development company, devised process for making tetraethyl lead.

Dr. W. K. LEWIS: Advisor to Standard Oil Company (N. J.) and pioneer contributor to fractional distillation.

Dr. N. E. LOOMIS: Since 1937 vice president of the Development company. Director of the experimental division, 1919 to 1927.

Dr. R. A. MILLIKAN: Famous physicist, and advisor when the old development department was created.

Dr. IRA REMSEN: Chemist, late president emeritus of Johns Hopkins, and advisor on the formation of the development department in 1919.

Dr. C. I. ROBINSON: Head of the chemical research department in 1918. Chief chemist in the development department, 1919 to 1923.

R. P. RUSSELL: Executive vice president of the Development company since 1937. Director of research at Baton Rouge, 1927-1930.

C. A. STRAW: Assistant to Mr. Howard, 1920 to 1922. Vice president of the Development company from 1922 to his death on Jan. 9, 1931.

effected in substituting continuous in place of batch operations throughout the refineries and in conserving heat and energy through better designed equipment. In the years that followed there were such developments as the ethyl chloride process for tetraethyl lead manufacture, the application of high pressure hydrogenation in petroleum refining, the fluid catalyst process for the production of high octane base stock and alkylation feed stocks essential to the country's gigantic 100 octane program, the production of synthetic nitration grade toluol from petroleum, and the all important contributions to the synthetic rubber program.

Since the entry of this country into the war the company's contributions have immensely increased in scope. It has served as an emergency technical arm to our Army and Navy. Of this work little can be written during the war, except for the developments carried out for the Chemical Warfare Service which brought the company the Army-Navy "E" in March, 1943, and subsequently two stars for continued merit. This work for CWS included the development of a new type of large-area smoke screen generator, the production of a revolutionary type of oil incendiary bomb, and the development of a new and far more effective flame thrower.

At the present time 98 percent of the work of the large staff goes into war effort. In 1943 alone the laboratories and work shop of the Development company devoted something over 2,500,000 man-hours to war research. During the years 1942 and 1943 the company expanded more than $6,000,000 a year on research. The effect of this enormous volume of work has been to develop new military uses of petroleum in addition to its many peacetime applications.

Oil products serving literally hundreds of uses, make up nearly two-thirds of all the war supplies that go overseas today. The processes which enter into this tremendous tonnage have in many cases had to be specially developed to meet specific war demands. Many of those processes were worked out either wholly or in part by Standard Oil Development Co. They are the fruits of 25 years of the expanding application of science to petroleum technology.

FORECASTING

When the twenty-fifth anniversary approached the company decided that the most useful contribution it could make in commemoration of the event would be the sponsoring of a forum for discussions which would aid in forecasting the probable future responsibilities of industrial research and development organizations of all kinds. Such discussions are of immediate and vital interest not only to the managers of industrial research but also to those concerned with the government's part in and attitude toward research by industry, and to those who report to the public on such questions.

Taking part in the forum were many of the leaders of industry, government and educational institutions. The forum was divided into two sessions. At one of these the speakers discussed how small business can serve itself by industrial research and development. This discussion appears on pages 102 and 103 of this issue. The other session was concerned with the guiding principles and objectives of industrial research and development organizations.

. . . OF UNPRECEDENTED SCOPE

This latter session was under the chairmanship of Dr. Charles F. Kettering, general manager, research laboratories, General Motors Corp. In discussing the subject from the view of industrial management, Harry L. Derby, president of American Cyanamid and Chemical Corp., expressed the opinion that research programs will have served their purpose if, as a result, the life of man is prolonged, his health and comfort are improved, his happiness is enhanced, and his productive ability and usefulness are enlarged. He believes that most of the new inventions, and particularly those with which this group was primarily concerned, contribute to that program. The inventions of the petroleum industry have enabled man to attain speed on land and sea heretofore unknown. They have made flight through the air at a maximum velocity possible. They have in many ways increased man's usefulness and increased his ability to produce more goods and services. The Roman emperors, with all their gold-trimmed chariots, never even visioned the luxury of riding over a modern concrete highway in a present-day automobile. The peoples of the nations have been brought closer together and have become neighbors through these inventions. This may be for good or for evil if wars are to continue, but the inventions and developments which have been created offer business opportunities of unprecedented scope.

The physicist's view of the question before the forum was presented by Dr. Frank B. Jewett, vice president, the American Telephone & Telegraph Co., and chairman of the board, Bell Telephone Laboratories. Dr. Jewett stated that in the industrial field the place of chemistry and physics and f men widely trained in them has become established during the past two or three decades. No industry can now be secure or hope to grow without them, he believes. This is because exact knowledge of the fundamental science and the methods by which it is derived provide the holders of it with powerful but facile tools with which to fashion new things of utility.

Because the methods which science uses, both fundamental and applied, are so powerful and certain in achieving the ends sought, money spent through well organized research and development departments is the least risky and potentially the most profitable of all the expenditures in which industry ventures capital, he believes. The late Thomas Midgley, Jr., president, American Chemical Society, presented the chemist's view of the future of industrial research. He stated that probably no other field holds more and varied promises for successful industrial research than chemistry: success for the investigator who may satisfy his curiosity about the unknown with a fair share of honor and wealth; success for industry which may increase its payroll, its output and its profits; and success for the public who will reap the benefits of better health, higher standards of living and a safer world in which to live and travel. Dr. Midgley mentioned two catches to this charming picture. First is the recent apathy the public has shown toward raising its standard of living. It is discouraging to develop new things or to open the way to better comfort just to have the public yawn and say, "So what?" Unless the public cooperates and raises its living standards as rapidly as industrial research makes it possible, unemployment is the result. He wants the public to supply itself with the thousand useful articles that research will improve after the war.

A SECOND CATCH

The second catch to immediate expansion of our industrial research is the lack of properly trained personnel in the chemical fields. The war has already eliminated three years of the normal supply of college graduates and if the upward surge of research takes place after the return of peace which we all hope for, we will find ourselves very short of professional chemists and chemical engineers. There will almost certainly be a decided rise in salaries as competitive industry again gets under way. This will not be bad for the chemists and chemical engineers who are already in industrial work, but its repercussions on the educational situation may be quite disastrous. The universities are in no position to bid, financially, for the services of the younger men who are needed as instructors, later as assistant and associate professors and still later as full professors and heads of departments. Industry should take heed of this situation before it gets out of hand. By ample fellowships both in size and number it should encourage many young men to remain in educational work in order that its own full needs can be met in the near future.

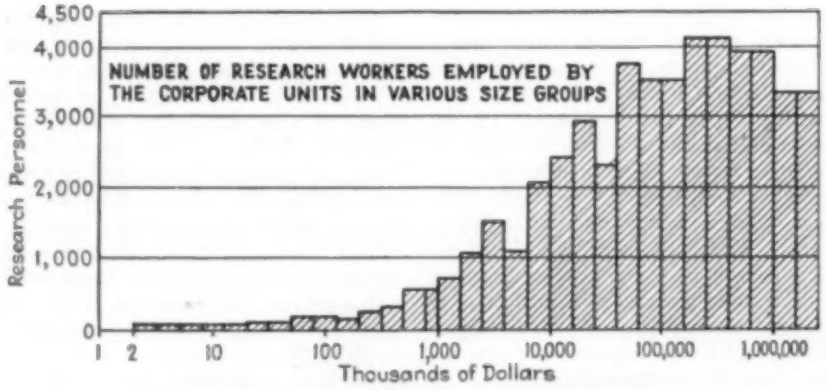
Copies of the complete papers that were delivered at the silver anniversary forum of the Standard Oil Development Co. on the future of industrial research and the discussion in which many other industrial leaders participated are available.

EDITORIAL STAFF REPORT

INDUSTRIAL RESEARCH

How Can It Be Made to Serve Small Business?

Is research a luxury which only the larger, richer companies can afford? Is small business forever barred from using it as a means of entering new fields of enterprise? The answer to both questions is an emphatic "No" as was clearly shown by the unique symposium reported in these pages.—*Editors*



Tangible net worth of individual corporate units

TOO OFTEN attention is directed to the results of research, to the glamour and magic of its achievements. Too seldom are we told what it costs—except in casual references to the millions annually appropriated by the big companies that can spread such costs over large volumes of business. The smaller manufacturer sometimes becomes discouraged and eventually his complaints are echoed in the halls of Congress by those who would abolish our patent system and regiment research under governmental "coordination."

To correct such misunderstandings and show the positive, constructive side of this picture was undoubtedly one of the purposes behind the unique symposium sponsored by the Standard Oil Development Co. in celebrating its silver anniversary on October 5. The subject of this session was: "How can small business serve itself and be served by industrial research and development?" The chairman was the eminent chemical engineer and energetic proponent of research in industry, Prof. Warren K. Lewis of the Massachusetts Institute of Technology. With characteristic vigor he marshalled his facts and speakers to show that there are at least a half dozen different ways in which any company, large or small, can engage in research to improve its products or processes. These methods or procedures (as will later be developed in greater detail) center around research by business itself, by trade associations and cooperative groups, by professional research organizations, by endowed foundations and institutes, and by the federal government. For each of these plans there were strong and able proponents.

SHOULD ROLL ITS OWN

Edwin H. Land, 35-year-old president of the Polaroid Corp., a self-admitted "research addict," holds that "small business must roll its own research program." In the future every successful enterprise must be a research project in which every capable man can share in creative effort without becoming a part of a great inanimate machine. So organized and energized, a small business can do in two years what its big competitor could not do in twenty. Once it is in the lead, technologically, it can afford to change its products every few years—to maintain the only safe sort of monopoly, that of leadership. The only danger in all this, according to the youthful inventor and executive, is that if the small business does too much research it may become a big company. What then? Mr. Land suggested growth by fission. That is to say, when a company reaches some arbitrary size, perhaps between 500 and 2,000 employees, some of its younger men should be encouraged to take one of the new developments and start a new company in which the parent company would have an interest and partial control for only a few years. "Such a program," he said, "seems to approximate an attractive individual counterpart of Jefferson's concept of an American agricultural democracy."

THE INDUSTRIAL RESEARCH INSTITUTE

Cooperative research takes many forms but one of the most promising procedures developed in recent years is the establishment of an industry research institute, often set up in collaboration with an educational institution in which studies of both fundamental and applied science can be prosecuted for the direct benefit of the sponsors and for the indirect benefit of the entire industry. Perhaps the pioneer in this type of cooperative research is the Institute of Paper Chemistry, at Lawrence College, Appleton, Wis. It was appropriate, therefore, that the experience of this enterprising organization should be presented by its executive director, Westbrook Steele.

One of the leaders of the paper industry was quoted by him as saying that "the outstanding feature of the Institute is a recognition that man is the common denominator of all problems . . . that an industry's success is depenent upon the wisdom and stature of the men who comprise it." Thus it is that one of the chief products of the Institute is its annual crop of graduates who have been highly trained in the methods and viewpoint of research. Started in 1929 with 19 companies, the Institute now draws its support from one

hundred. At the beginning it represented 90 percent of the production of one state. Today its support comes from 70 percent of the total production of pulp, paper and board of the entire country. "The Institute of Paper Chemistry stands as a symbol of a most productive partnership—education and industry."

PRODUCT: 100 PERCENT RESEARCH

Speaking for a company whose only product is research, Earl P. Stevenson, president of Arthur D. Little, Inc., reported that, contrary to popular opinion, it is the larger company, rather than the smaller one, that usually employs the services of a research consultant. For example, only 20 percent of the Little clients are small companies and they contribute less than 5 percent of the total income derived from professional services. One of the reasons for this is the difficulty the smaller company has in recognizing and defining its problems. Another is the need for at least one competent research-minded executive, preferably technically trained, who can work with a consultant and see that the findings are intelligently and usefully applied.

Conclusions drawn by Mr. Stevenson from a number of years of work with small companies are that: (1) There is a widespread and intelligent interest in research by business executives in small companies, (2) more funds are available than are being spent, (3) opportunities for research and development are recognized, (4) the missing element is in technical and scientific manpower.

"Many small companies, if they are to compete and assuredly if they are to grow, must learn first to compete for technical personnel. If competent technical personnel is intelligently absorbed and utilized, effective research will follow almost automatically. There are ample facilities available for advice, consultation, and direct and continuing assistance. Organized bodies, like that sponsored by the New England Council, exist or are being created to facilitate the use of such assistance. Many small companies are probably aware of the significance of research, but many of them are still unaware of the methods by which research can be utilized within their budgets and their organizational structure. The need now is not for more sources of assistance or free service—research breadlines—the need is rather for education of small company management in the advisability of employing technical personnel and in methods of utilizing research assistance now available. These needs, unfortunately ,are still great. Ours is a commodity of scarcity."

Unusual facilities for investigation of the scientific problems of American industries are available in a limited number of privately endowed research foundations. One of these of prominence in a number of industrial fields is the Battelle Memorial Institute of Columbus, Ohio, whose director, Clyde E. Williams, outlined the types of service that can best be used by small companies. For relatively small expenditures, the research foundation can provide access to the scientific and technical knowledge of a field, can assist in making appraisals of the type of research needed or the direction in which development should be undertaken and, finally, it can provide the facilities of laboratories well equipped for almost any type of investigation. The research foundation can also protect the sponsor-company's interest by retaining a patent consciousness and by assigning its inventions to the sponsor.

"Companies experienced in industrial research know that patience, time and money are needed to bring even a well-conceived project to a successful conclusion. Small business must not make the mistake of believing otherwise. Experience indicates, however, that important developments may result from research investigations carried on over a period of several years, at an expenditure of as little as $10,000 to $15,000 a year."

RESEARCH BY GOVERNMENT

For the fiscal year 1936-7, the U. S. Government spent about $120 million for research, or approximately 2 percent of its annual budget. Of this, about one-third went to agriculture, a fifth to aviation, another fifth to the military and the remainder was divided largely between the Departments of Commerce and Interior. The Bureau of Mines has long been one of the most important governmental research agencies and it was appropriate to have a paper prepared by Arno C. Fieldner, chief of its fuels and explosives branch. In his absence due to illness, it was presented by his associate, William Schroeder.

According to its organic act, the Bureau of Mines is authorized by Congress ". . . to conduct inquiries and scientific and technologic investigations concerning mining and the preparation, treatment, and utilization of mineral substances, with a view to improving health conditions and safety, increasing efficiency, economic development and conserving resources through the prevention of waste in mining, quarrying, metallurgical and other mineral industries. . . ." The Bureau has served as a connecting link between research agencies as well as between producing and consuming interests. It is not responsible to any special group, according to Mr. Fieldner, but "owing to its status as an impartial organization, it can render assistance in solving controversial problems of technology or giving advice on subjects in which the public interest is paramount."

The following projects of the Bureau were cited as those most likely to yield information useful to small industries:

1. The survey of the chemical and physical properties of American coals, including tests for assessing their suitability for various uses such as combustion, carbonization, gasification, liquefaction, and the production of various chemical products.
2. Development of methods and equipment for increasing efficiency in utilizing coal as a fuel in small industrial plants.
3. Reduction of losses from spontaneous combustion and fires in coal mines and storage piles.
4. Investigation of evolution of flammable or noxious gases from coal to improve ventilation in coal mines.
5. Study of mechanism of ignition and propagation of gas and dust explosions with a view to prevention or control.
6. Study of new methods of mining to increase recovery of coal and of methods of preparation that will reduce the loss of good coal in the refuse.
7. Research on the increase of safety in mining coal through the use of explosives and electrical equipment that will not ignite explosions and the development of means for reducing roof falls, which in themselves are responsible for a large share of accidents to coal miners.
8. Research on reduction of stream pollution from washery wastes and acid mine water through the development of practical methods for minimizing these wastes without imposing onerous costs on the industry.

To round out his symposium, Chairman Lewis called on a number of leaders of smaller industries to report their experiences. Morehead Patterson, president of the American Machine & Foundry Co., said that something must be done to "condition the mind of management to accept and use research. That job might well be undertaken by some of our educational institutions." Fred W. Willard, president of the Nassau Smelting & Refining Co., suggested that research expenditures should be calculated as a percentage of salaries and wages rather than of gross sales. John Anderson, auto appliance manufacturer, warned against the misguided efforts of legislators who would control research and thus rob us of incentive to create. "Keep in mind," he said, "that large business and small business are fundamentally interdependent."

T. G. Delbridge of the Atlantic Refining Co., and past-president of the American Society for Testing Materials, spoke highly of the cooperative research work that had been sponsored by the petroleum and automotive industries. An apology for having graduated from Cornell University rather than M.I.T. brought from the chairman the somewhat startling conclusion that none of our schools and colleges have yet fully met the needs of American industry. The greatest unfilled demand today is for technical manpower, he said, particularly for men who have been adequately trained in the research technique. That can probably best be done in our universities which thus become "our most basic sources for new wealth."

FRANK TALBOT
Chief of the Program and Statistics Branch, Chemicals Bureau, War Production Board, Washington, D. C.

SULPHURIC ACID

Estimated Supply and Requirements

Survey of sulphuric acid situation made by Chemicals Bureau, WPB, finds that productive capacity by the end of next June will have been increased by 12.5 percent over that in existence at the end of 1943. Estimated acid requirements for this year and for the first half of next year run far ahead of what current estimates regard as the supply which will be available for those periods from all sources.—*Editors*

BECAUSE of expanding requirements for sulphuric acid in the latter part of 1943 and throughout most of 1944, largely as a result of increases in the output of aviation gasoline, military explosives, superphosphates, and other products, it was found necessary to determine as accurately as possible the estimated supply and requirements of this acid for 1944 and for the first six months of 1945. In order for the Chemicals Bureau to know where new sulphuric acid plants might be required and in what regions of the United States it might be necessary to resort to some type of allocation control, it was found desirable to subdivide the United States into 10 areas and determine the sulphuric acid supply and requirements of each.

The sulphuric acid shortage is largely a regional problem and it is not always possible to take care of large new local requirements though the over-all balance may be favorable. Although sulphuric acid is used in many different grades and concentrations, all quantities shown in this article are on the basis of 100 percent acid.

The complexity of the sulphuric acid supply is such, that in many instances, it is extremely difficult to estimate just what will be the quantity of acid available to meet the requirements of a given area. In estimating the supply and requirements of acid for any given area it was found that a true picture could not be arrived at by considering net requirements compared with the supply of virgin acid, therefore, the quantity of available spent acid that could be utilized in each area was included as part of the supply. Spent acid from one process often is the source of acid for a secondary use. For example, oleum for TNT may be used in its spent form for making other explosives, and the spent acid from these explosives for still other products.

The supply of ordnance produced sulphuric acid, and the quantity of spent ordnance produced acid that may be available for private consumption are not included in these supply and requirement figures.

SULPHUR MATERIALS

Information from manufacturers is available indicating that in 1942 a total of 2,714,600 short tons of sulphur—that is in the form of brimstone or sulphur-containing materials—was consumed in the manufacture of sulphuric acid in other than ordnance plants. Of this, approximately 66.8 percent or 1,812,700 short tons was brimstone; 10.8 percent, or 294,800 tons of sulphur, was contained in other materials. Included among the other materials containing sulphur are zinc and copper ores, ferrous sulphate, hydrogen sulphide, and spent alkylation acid. The quantity of spent alkylation acid used in 1942 was small but its use increased in 1943 and 1944 as a result of the large rise in the use of sulphuric acid in the alkylation process for aviation gasoline and in the completion of the construction of sulphuric acid plants using spent alkylation acid as the source of sulphur.

Sulphur Consumed in Sulphuric Acid Short Tons, 1942, by Areas

Area	Brimstone	Sulphur Content of Pyrites and Other Materials	Total
1	48,900	2,000	50,900
2	578,500	205,300	783,800
3	288,100	252,500	540,600
4 & 5	119,700	130,600	250,300
6	265,900	21,600	287,500
7	150,400	72,800	233,200
8	139,800	31,700	171,500
9	191,600	23,600	215,200
10	29,800	161,800	191,600
	1,812,700	901,900	2,714,600

Annual capacity to produce sulphuric acid, in other than ordnance owned plants, will, after the present new contemplated construction is completed by June 30, 1945, reach a total of 9,426,600 short tons. This will be 12.5 percent larger than the capacity of 8,393,100 short tons at the close of 1943. In the Pacific, capacity at the close of June 1945 will be 53 percent greater than as of Dec. 31, 1943; in the Southwest, 43 percent greater; in the Upper Ohio River, 19 percent greater; in the Lower Ohio River, 17 percent greater; in New England, 14 percent greater; and in the Middle Atlantic, 5 percent greater.

Sulphuric Acid Capacity, Tons of 100 Percent Acid per Year

Area	Actual Capacity Dec. 31, 1943	Estimated Capacity June 30, 1944
1	183,800	209,000
2	2,403,000	2,524,600
3	1,426,800	1,468,500
4 & 5	771,300	913,700
6	839,200	839,200
7	699,600	699,600
8	569,200	569,200
9	850,900	1,215,700
10	637,300	975,100
	8,393,100	9,426,600

An accompanying table shows the actual or estimated capacity, other than ordnance, to produce virgin sulphuric acid by areas of the United States as of Dec. 31, 1943 and June 30, 1945. The increase in capacity to produce acid during this period is almost entirely due to new plants that have been constructed or will be constructed and are likely to be completed before June 30, 1945.

ESTIMATED SUPPLY

In addition to the production of virgin sulphuric acid, a large quantity of spent acid from private industry, and particularly spent alkylation acid from aviation gasoline refineries, is available and finds use in meeting part of our requirements. Although spent acid may be available in large quantities the uses are limited, therefore, only that part of the available spent

acid that can be utilized has been considered as part of the supply for a given area. From time to time spent acid has also been made available by ordnance plants and has been used when available in superphosphate manufacture. Spent acid from ordnance plants when it could be obtained has been helpful in relieving the shortages of acid available for superphosphate manufacture particularly in areas 2 and 3.

In estimating the supply of acid for the year 1944, we have included for each area the actual production of virgin acid for the first half of the year and estimated the production for the last half as equivalent to rated capacity. In general the sulphuric acid industry during 1944 will operate at close to 100 percent of capacity. During the first six months the industry operated at 98 percent of rated capacity. The supply of virgin sulphuric acid for the first half of 1945 is considered also as equivalent to rated capacity.

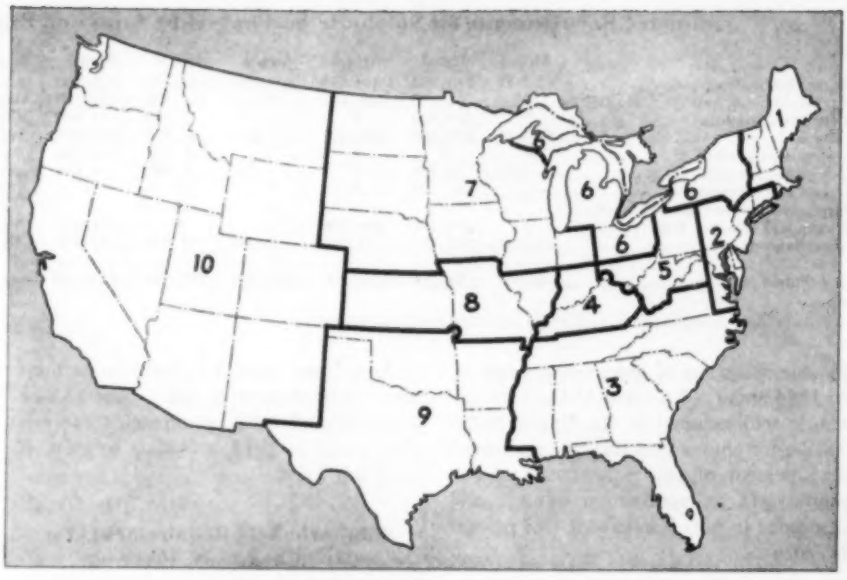
Estimated Requirements of Sulphuric Acid by Areas, Tons

Area	1944 Requirements	Percent of Total	1945, 1st 6 mo. Requirements	Percent of Total
1	164,300	1.6	95,200	1.7
2	2,884,300	27.3	1,445,300	25.5
3	1,948,000	18.5	1,007,300	17.8
4	220,200	2.0	116,300	2.0
5	777,200	7.4	405,400	7.2
6	813,200	7.7	427,200	7.5
7	943,600	8.9	498,110	8.8
8	788,100	7.5	400,900	7.1
9	1,045,500	9.9	686,900	12.1
10	971,800	9.2	581,000	10.3
	10,556,200	100.0	5,663,600	100.0

Estimated Supply and Requirements for Sulphuric Acid, Tons

Area	1944 Estimated Supply	Estimated Requirements	Surplus or Deficit
1	175,700	164,300	11,400
2	2,740,200	2,884,300	−144,100
3	1,696,400	1,948,000	−251,600
4 & 5	767,400	997,400	−230,000
6	803,000	813,200	−10,200
7	816,900	943,600	−126,700
8	588,100	788,100	−200,000
9	1,104,200	1,045,500	58,700
10	958,800	971,800	−13,000
	9,650,700	10,556,200	−905,500
	1945—First Six Months		
1	104,400	95,200	9,200
2	1,403,900	1,445,300	−41,400
3	848,200	1,007,300	−159,100
4 & 5	458,500	521,700	−63,200
6	421,600	427,200	−5,600
7	407,300	498,100	−90,800
8	304,400	400,900	−96,500
9	736,400	686,900	49,500
10	586,300	581,000	−14,700
	5,251,000	5,663,600	−412,600

Consuming requirements for sulphuric acid were determined by areas for the following uses: superphosphate, normal and triple; ammonium sulphate; petroleum refining; chemicals; iron and steel pickling; other metallurgical; pigments, titanium dioxide and others; explosives, from other than ordnance acid; rayon and cellulose film; and miscellaneous. It is estimated at the present time (Sept. 1, 1944) that the 1944 total requirements for sulphuric acid will be 10,556,200 short tons and for the first six months of 1945 requirements will be 5,663,600 short tons.



Approximate Location of the 10 United States Subdivisions

Area No. 1—New England: Maine; New Hampshire; Vermont; Massachusetts; Rhode Island.

Area No. 2—Middle Atlantic: (a) New York Harbor—New York City; North New Jersey; Connecticut; (b) Delaware Bay—Delaware; Eastern Pennsylvania; South New Jersey; (c) Delaware-Norfolk—Virginia, Norfolk District; Maryland, except Cumberland.

Area No. 3—Southeast: Tennessee; Virginia, except Norfolk and Front Royal; North Carolina; South Carolina; Georgia; Alabama; Florida; Mississippi.

Area No. 4—Lower Ohio River: Kentucky, except Wurtland; Southern Indiana; Cincinnati, Ohio.

Area No. 5—Upper Ohio River: Western Pennsylvania; Western Maryland (Cumberland); West Virginia; Southern Ohio, except Cincinnati; Kentucky (Wurtland); Virginia (Front Royal).

Area No. 6—Great Lakes: New York (except part in 2); Michigan; Northern Ohio.

Area No. 7—Middle West: Indiana, except southern; Wisconsin; Illinois, except southern; Minnesota; Iowa; Nebraska; South Dakota; North Dakota.

Area No. 8—St. Louis: Missouri, except Joplin; Kansas; Illinois southern.

Area No. 9—Southwest: Oklahoma; Texas; Arkansas; Louisiana; Joplin, Missouri.

Area No. 10—Pacific: (a) San Francisco, Calif.; (b) Los Angeles, Calif.; (c) Idaho; Montana; Wyoming; Nevada; Utah; Colorado; Arizona; New Mexico; (d) Washington; Oregon.

SUPERPHOSPHATE

Manufacture of superphosphates including normal 18 percent and triple 45 percent has been handicapped by lack of manpower and by shortages of sulphuric acid. Although it had been expected that munitions manufacture would make available large tonnages of spent sulphuric acid this has often not been the case as improved methods have enabled the explosives plants to purify and reconcentrate their spent acid for re-use.

About one ton of 100 percent acid is required for 2.85 tons of normal superphosphate (18 percent), while one ton of triple superphosphate requires about one ton of sulphuric acid. Some triple superphosphate is made by TVA, however, by the electric furnace process.

The requirements of sulphuric acid for combined normal and triple superphosphates for the year 1944 and the first six months of 1945 are based upon the actual production of superphosphates for the first two quarters of 1944 and an estimated output during the period July 1, 1944-June 30, 1945 of 8,000,000 short tons of 18 percent superphosphate and 325,000 tons of triple superphosphate. If this goal is reached the total output of normal and triple superphosphate during the fertilizer year 1944-1945 will be equivalent to approximately 8,812,500 short tons of 18 percent superphosphate.

In the calendar year 1944 it is estimated that 2,852,900 short tons of sulphuric acid or 27 percent of the total requirements of acid in that year will be needed by manufacturers of normal and triple superphosphate. Of the total acid required in 1944 for superphosphate about 47.1 percent or 1,344,000 short tons will be needed in Area 3 and 718,700 short tons in Area 2.

AMMONIUM SULPHATE

Most of the ammonia recovered from coke ovens is converted to ammonium sulphate which is an important source of fertilizer nitrogen. In addition to by-product ammonium sulphate there is some production of synthetic sulphate.

Requirements of sulphuric acid for ammonium sulphate for the year 1944 and the first half of 1945 as shown herewith are based upon an estimated byproduct and synthetic output of 896,000 short tons in 1944 and of 473,000 short tons in the first half of 1945. About 0.76 short tons of sulphuric acid, 100 percent, are required

Estimated Requirements for Sulphuric Acid in 1944 by Areas and Principal Consuming Uses, Tons

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Total
Superphosphate	44,900	719,700	1,344,400	90,800	48,400	126,800	123,800	95,000	173,400	85,700	2,852,900
Ammonium sulphate	*	91,300	69,100	*	197,700	127,100	108,700	*	*	73,800	694,500
Petroleum refining	*	220,100	*	.....	12,600	14,500	128,600	76,800	620,100	401,100	1,477,000
Chemicals	68,000	809,600	106,000	62,800	94,000	200,000	341,400	187,500	133,300	186,000	2,188,600
Iron and steel pickling	*	*	*	*	197,300	146,900	91,200	.....	.....	*	558,400
Other metallurgical	500	33,400	*	500	3,600	6,400	*	*	*	129,900	343,000
Paints and pigments	.....	491,900	*	*	*	*	*	241,200	.....	*	767,100
Explosives, other than ordnance	.....	*	*	*	*	*	*	*	*	*	742,600
Rayon and cellulose film	*	94,900	166,800	.....	*	74,300	12,500	.....	.....	.....	528,100
Miscellaneous	25,600	109,000	34,000	8,400	25,200	71,200	56,700	13,000	25,700	35,200	404,000
Totals	164,300	2,884,300	1,948,000	220,200	777,200	813,200	943,600	788,100	1,045,500	971,800	10,556,200

* Data not publishable but they are included in totals.

for one short ton of ammonium sulphate. In 1944 about 6.5 percent of the total sulphuric acid required in the United States will be for ammonium sulphate and about 28.5 percent of the requirements of sulphuric acid for ammonium sulphate will be needed in Area 5 and about 18.3 percent in Area 6.

PETROLEUM REFINING

The large requirements for sulphuric acid for the alkylation process for aviation gasoline has placed a heavy demand on our sulphuric acid supply on the Pacific Coast and in the Southwest. The alkylation process for the manufacture of aviation gasoline requires 98 percent sulphuric acid and the spent alkylation acid obtained as a byproduct contains about 88 percent acid.

Spent alkylation acid may be used as a feed stock for the recovery of sulphur; for treatment of lubrication oils or naphthas; it may be hydrolyzed and used for superphosphates and other miscellaneous uses; and it may be hydrolyzed, concentrated, and refortified with SO_2.

In 1944 the estimated requirements of sulphuric acid for petroleum refining are 1,477,000 short tons or about 14 percent of total United States requirements and for the first six months of 1945 are estimated as 890,000 short tons or 16 percent of total requirements. It is expected that the requirements for this use will be about 10 percent larger in the first half of 1945 than in the last half of 1944. In 1944 about 42 percent of the total requirements of sulphuric acid for petroleum refining will be for the Southwest and 27.2 percent for the Pacific Coast.

CHEMICALS

Sulphuric acid is used extensively in the manufacture of many chemicals. Some f these which require large quantities of sulphuric acid are phosphoric acid, sulphate of alumina, hydrofluoric acid, nitric acid, hydrochloric acid, ethyl alcohol, isopropyl alcohol, copper sulphate, many coal-tar intermediates, dyes, and non-coal-tar organic chemicals.

In 1944 the sulphuric acid requirements for chemical manufacture are estimated at 2,188,600 short tons or about 20.7 percent of the total estimated requirements.

Area 2 and Area 7 include the sections where consumption of acid is largest. The percentage of total requirements for sulphuric acid in 1944, according to areas, is as shown below:

Sulphuric Acid Requirements for Chemicals, 1944

Area	Percent	Area	Percent
1	3.1	6	9.1
2	37.0	7	15.6
3	4.8	8	8.6
4	2.9	9	6.1
5	4.3	10	8.5
			100.0

IRON AND STEEL

In the steel industry "cleaning" is defined as the removal of scale and other forms of iron oxide as well as oil and grease from the surface of iron and steel. Pickling is a more restricted term and usually applies to the removal of undesirable foreign substances such as scale and oxide with acid solution. Pickling usually is done electrolytically in an acid bath or through chemical action. Many steel products such as rails, structurals, and heavy plates are not pickled. Others that require a high finish or a polished surface may be pickled several times. Steel that is to be coated with tin, zinc, or other metals must be pickled to cleanse and prepare the surface before the application of the coating.

In electrolytic pickling sulphuric acid is used as above or in combination with other acids as an electrolyte. As distinguished from the electrolytic method, the chemical method relies on the action of the acid on the scales and oxide and on the steel base to accomplish the pickling. It is essential that pickling be done as rapidly as possible to reduce iron loss to a minimum. To assist in the removal of the scale and oxide, therefore, the pickle bath is worked at a high temperature and various methods of agitation are resorted to. There also is continuous pickling in which the sheets or strips are welded end to end and passed through a series of acid baths.

To minimize the iron loss certain substances are used as inhibitors. These prevent action of the acid on the base metal but permit the reactions that result in the removal of the oxide or scales. They also cut down on the evolution of hydrogen which may be absorbed by steel and cause brittleness or may result in blisters when the steel is subsequently subjected to high temperatures in coating.

In 1944 about 558,400 short tons of acid will be needed for iron and steel pickling. This is about 5.3 percent of total acid requirements in that year.

OTHER METALLURGICAL USES

Among the metallurgical uses, other than pickling in the steel industry, sulphuric acid is used in large quantities in the treatment of copper, zinc, and vanadium ores, and in smaller quantities for pickling in brass mills. In 1944 it is estimated that 343,000 short tons of sulphuric acid will be required for other metallurgical uses.

Sulphuric Acid Production, 1941–42, Tons

	Chamber	Contact	Total
1941	3,011,929	3,758,155	6,770,084
1942	2,914,722	4,839,258	7,753,980

Data for contact acid include acid of oleum grade and some spent acid.

Sulphuric Acid Production, 1943 and First Six Months of 1944, Tons

	1943			1944—First Six Months		
Area	Chamber	Contact	Total	Chamber	Contact	Total
1	*	163,750	163,750	*	75,495	75,495
2	873,992	1,433,519	2,307,511	462,260	756,772	1,219,032
3	1,044,317	395,039	1,439,356	506,415	232,041	738,456
4 & 5	311,654	371,998	683,652	170,695	198,199	368,894
6	352,438	416,584	769,022	166,598	212,810	379,408
7	292,294	377,878	670,172	161,685	204,047	365,732
8	*	577,190	577,190	*	276,153	276,153
9	48,154	623,430	671,584	28,177	433,507	461,684
10	*	567,738	567,738	*	339,873	339,873
	3,148,014	4,701,961	7,849,975	1,617,117	2,607,610	4,224,727

* Chamber acid included with contact to avoid disclosure of individual operations. Totals represent actual acid produced, excluding spent acid.

Estimated Requirements for Sulphuric Acid in First Half 1945 by Areas and Principal Consuming Uses, Tons

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Total*
Superphosphate	35,200	360,300	699,500	51,400	26,000	66,200	78,800	47,800	139,600	53,800	1,558,600
Ammonium sulphate	*	49,500	35,400	*	102,300	64,300	56,600	*	*	37,500	361,200
Petroleum refining	*	106,000	*	.....	6,300	7,300	69,700	40,300	390,700	269,000	890,900
Chemicals	34,000	404,800	53,000	31,400	47,000	100,000	170,700	93,700	89,800	105,600	1,130,000
Iron and steel pickling	*	*	*	*	100,200	82,200	46,500	.....	.....	*	291,700
Other metallurgical	300	16,700	*	200	1,800	3,200	*	*	*	66,600	174,500
Paints and pigments	.....	246,800	*	*	*	*	*	125,000	.....	*	389,600
Explosives, other than ordnance	.....	*	*	*	*	*	*	*	*	*	375,400
Rayon and cellulose film	*	49,500	88,400	.....	*	45,400	6,200	.....	.....	.....	289,300
Miscellaneous	12,800	54,500	17,000	4,200	12,600	35,600	28,400	6,500	13,600	17,200	202,400
Totals	95,200	1,445,300	1,007,300	116,300	405,400	427,200	498,100	400,900	686,900	581,000	5,663,600

* Data not publishable but they are included in totals.

PIGMENTS

Sulphuric acid is consumed in the manufacture of titanium pigments. Titanium dioxide which is obtained from ilmenite is the most important of these and finds large use as a white pigment in paint, varnish, lacquer, and also in paper, linoleum, rubber, coated textiles, leather, and printing inks. Titanium dioxide also is used in ceramics and in welding rod coatings. In addition to its use in the manufacture f titanium pigments, sulphuric acid is also required in producing lithopone, zinc sulphide, and other pigments.

In 1944 an estimated 767,100 short tons, or 7.3 percent of the year's total sulphuric acid will be required for paints and pigments. Of the 767,100 tons required, about 64.1 percent will be needed in the Middle Atlantic area and 31.4 percent in Area 8.

EXPLOSIVES

The requirements for explosives as shown herewith includes acid for making industrial explosives and military explosives manufactured from acid obtained from other than ordnance sulphuric acid. The requirements for military explosives manufactured from ordnance produced sulphuric acid are not included in these requirements.

RAYON AND CELLULOSE FILM

Domestic production of rayon yarn and staple fiber have increased from 380 million lb. in 1939 to an estimated 750 million lb. in 1944. Of the total domestic production of filament yarn in 1943 about 66 percent was viscose rayon. Included in the cellulose film industry are such products as cellophane, viscose casings, caps and bands, and cellulose sponges.

In 1944 about 528,100 short tons of 100 percent acid will be required for rayon and cellulose film and of this total about 31.6 percent will be needed in Area 3, and 18 percent in Area 2.

Among the many of the large miscellaneous consumers of sulphuric acid are: battery manufacture, rubber, food processing, soap, water conditioning, leather, metal cleaners, paper, and textiles. The 1944 requirements of sulphuric acid for miscellaneous uses is estimated at 404,000 short tons.

SURPLUS AND DEFICIT

The estimated supply, requirements, and surplus and deficit, for each area of the United States for 1944 and the first half of 1945 are shown in the following:

The deficit of 905,500 short tons in 1944 and 412,600 short tons in the first six months of 1945 will be alleviated, however, by several factors.

Ordnance spent acid, for example, was made available for superphosphates in the first two quarters of 1944 at a rate of about 100,000 short tons per quarter. In the third quarter only 15,000 tons of ordnance spent acid will probably be available while the quantities of such acid that will be available for the fourth quarter of 1944 and the first two quarters of 1945 cannot be estimated at this time.

In addition to the supply of ordnance spent acid there are certain other factors to be considered. In many instances, the manpower shortage, particularly at superphosphate plants, is such that it is unlikely that this industry can operate at the desired level until Germany is defeated. Some superphosphate plants may also be limited in their output by the availability of phosphate rock and of transportation.

In the petroleum refining industry we have included requirements for sulphuric acid at the level which the petroleum industry has indicated it will require. Many factors incidental to the operation of facilities of this type may well result in a lower consumption of acid than the estimated requirements would indicate.

In the early part of 1944 the supply of acid on the Pacific Coast was inadequate. The situation was handled by placing sulphuric acid in that area under allocation and by the middle of 1944 the needs of consumers on the Pacific Coast were being satisfactorily met from the local supply which had been enlarged by new facilities.

About the middle of 1944 the situation in Area 9 became very tight although in the first half of the year supplies were adequate. Up until Sept. 1, 1944, it has not been necessary to place acid in Area 9 under allocation and it is expected that when new sulphuric acid plants are completed in that area the supply will take care of the increased requirements.

In Area 2 and Area 3 the supply of sulphuric acid, particularly for superphosphate, has been inadequate during 1944 to date and as a result many superphosphate plants have been unable to obtain as much acid as they could use. This situation may make it desirable to consider construction of more acid plants and control distribution by means of allocation.

Estimated Production of Sulphuric Acid and Available Spent Acid That Can Be Utilized, 1944 and First Six Months of 1945, Tons

	1944			1945—First Six Months		
Area	Production	Spent	Estimated Supply*	Production	Spent	Estimated Supply*
1	175,700	.....	175,700	104,400	.....	104,400
2	2,448,800	291,400	2,740,200	1,258,200	145,700	1,403,900
3	1,468,400	228,000	1,696,400	734,200	114,000	848,200
4 & 5	767,400	.....	767,400	458,500	.....	458,500
6	799,000	4,000	803,000	419,600	2,000	421,600
7	715,500	101,400	816,900	349,800	57,500	407,300
8	560,800	27,300	588,100	284,600	19,800	304,400
9	996,300	107,900	1,104,200	613,800	122,600	736,400
10	788,000	170,800	958,800	478,500	87,800	566,300
	8,719,900	930,800	9,650,700	4,701,600	549,400	5,251,000

* Does not include any ordnance produced acid or any spent acid that may be made available by ordnance plants.

Since the completion of this study of the sulphuric acid situation, WPB has announced that plans have been submitted for three new plants in the St. Louis area to prevent the anticipated shortage in that section. The Inorganic Acids Industry Advisory Committee has recommended construction of all three projects which include: Monsanto Chemical Corp., East St. Louis, Ill., to produce from 70,000 to 75,000 tons annually; National Lead Co., East St. Louis, to produce from 70,000 to 75,000 tons annually; and General Chemical Co., Newell, Pa., to produce oleum to balance the over-all shortage. The committee further agreed that new facilities to meet military requirements should be erected at the discretion of the Office of the Chief of Ordnance which is considering construction of government-owned plants with the following annual capacities: Charlestown, Ind., 75,000 tons and Tyner, Tenn., 75,000 tons.—*Editors*

TARVER S. MURPHY, JR. *Black, Sivalls & Bryson, Inc., New York, N. Y.*

RUPTURE DIAPHRAGMS

Characteristics, Uses and Size Calculation

The use of rupture diaphragms or disks for the protection of equipment against excessive pressure is by no means new, but their principles, applications and limitations are little understood, in spite of extensive use. Their importance has been further enhanced by their recognition in the 1944 addenda to the A.S.M.E. unfired pressure vessel code. The author has divided the subject into four main topics. The first three, dealing with the physical characteristics of rupture diaphragms, how and why they are used, and how the proper size for a given relieving capacity can be calculated, are treated in the present article. A second article, to be published shortly, will go at length into the difficult problem of predetermining the relieving capacity necessary for various systems.—*Editors*

With widespread increase in use of rupture diaphragms* for pressure relief and the protection of pressure systems, the questions most frequently asked, and ultimately of greatest importance, are: (1) How can the proper size of diaphragm be selected for required relief capacity? and (2) how can the required capacity for the pressure vessel or system be determined? The first question is treated in the present article, the second in an article to appear in a subsequent issue.

In full justice to the considerable dependability and protection expected of rupture diaphragms, a basic understanding of their characteristics in relation to the desired performance, and of the "how" and "why" of their use is first necessary, after which it will be possible to discuss the all-important questions of determining the proper size and required relieving capacity.

DIAPHRAGM CHARACTERISTICS

Bursting Pressure-Operating Pressure Ratio—It must be recognized that any rupture diaphragm (such as the typical examples in Figs. 1 and 2), gripped around its circumference for rupture from ultimate tensile failure, must be allowed a reasonable margin between the maximum pressure at which the equipment is intended to operate and the desired bursting pressure of the diaphragm. Otherwise, the diaphragm will fail at some lower pressure and after somewhat shorter service life than expected. This need of a fair operating margin probably applies to any type of rupture device. Tensile-rupture devices such as a Safety Head are analogous, in principle at least, to a tensile coupon in a testing machine. That is, if continuously or repeatedly stressed beyong its yield point a rupture diaphragm must inevitably "creep" or stretch until at some later time it fails at a lower stress than its known ultimate. While yield point-ultimate tensile relations vary for different diaphragm metals or alloys, it has been found over literally thousands of instances that a very satisfactory "rule of thumb" method can be used for determining a suitable minimum bursting pressure-operating pressure ratio. This minimum ratio allows sufficiently for the several more or less apparent factors involved, and provides long life for diaphragms without likelihood of premature rupture or necessity for frequent replacing to prevent rupture. Of course, if any wider margin or larger ratio can be allowed between bursting and operating pressures, then the diaphragm life is considerably further lengthened. The minimum suggested is:

For fairly steady, or non-pulsating service: Bursting pressure 1¼ times operating pressure.

For mildly pulsating, or partially cushioned pressure: Bursting pressure 1½ times operating pressure.

For highly pulsating pressure, or impact: Bursting pressure 2 times operating pressure.

With these mentioned ratios, it has been found that diaphragms will average some two to eight years' service life without premature failure, depending upon equipment operation, and excluding corrosive attack or improper installations and damage.

Effect of Temperature on Diaphragms—As all reference to diaphragms throughout this paper is to metal diaphragms (and only to those metals which have yield points approximately one-half or more of their tensile strengths) it is necessary to note the known effects of temperature on such metals in so far as temperature may affect the bursting pressure in diaphragm service.

Fig. 3 shows temperature-bursting pressure relationships for various metals as typical of those used in Safety Head diaphragm service. A material should be used which does not exhibit bursting pressure higher than the equipment can safely stand at any temperature likely to be experienced; provided of course, that it is possible for an overpressure condition to occur at the temperature in question.

To illustrate, many process and storage vessels will experience the desired or maximum allowable pressures only when certain temperatures prevail. Rupture diaphragms for such vessels should have their desired bursting pressures specified at the temperatures in question. On the other hand, if a vessel might experience its allowable pressure limit at some other temperature than intended, it then becomes necessary to use a diaphragm which will have its highest permissible bursting pressure at that temperature for which it is the strongest. This is especially true when the diaphragm controls primary relief requirements.

* Rupture disk assemblies made by the author's company are known as Safety Heads. Since the physical characteristics, performance and application limitations of various rupture disk designs vary widely, all comments in this and the author's second article regarding recommended relations between operating and bursting pressure, relieving capacity and like pertinent data are to be understood not to apply in their entirety to other rupture devices than Safety Heads.

From the curves of Fig. 3 it also can be seen that for many applications the rupture diaphragm may provide additional safety protection beyond that of bursting only when a predetermined pressure is reached. Should abnormally high temperature be experienced by the diaphragm in advance of or concurrent with a serious pressure increase, the bursting pressure for most diaphragm materials will decrease rapidly to permit relief all the sooner. In this respect diaphragms can provide much of the benefit sought from fusible plugs.

Another important temperature-pressure relation exists in the tendency for diaphragms of certain metals when subjected simultaneously to pressure and excessive temperature, to lose strength permanently in a manner similar to embrittlement or "cooking." This behavior has not yet been thoroughly enough investigated to permit exact analysis or correction. For the present it is suggested on the basis of past satisfactory experience, that diaphragm materials be selected by temperature limit from Table I, or else located so as to experience no higher temperature while under pressure, than those shown in Table I.

Table I—Maximum Temperatures for Various Diaphragm Metals

Diaphragm Material	Maximum Temperature, Deg. F.
Aluminum	300
Copper	350
Monel	600
Nickel	400
Platinum	600
Silver	300
Steel (mild carbon)	700
Steel (stainless)	500

Pressure-Vacuum Service—As a minor characteristic, it is perhaps well to mention that for pressure applications where reversal to vacuum may occur periodically, some form of support may be necessary for the diaphragm. This concerns diaphragms preformed to spheroidal contour, as well as disks initially installed flat which eventually assume a dished contour in service.

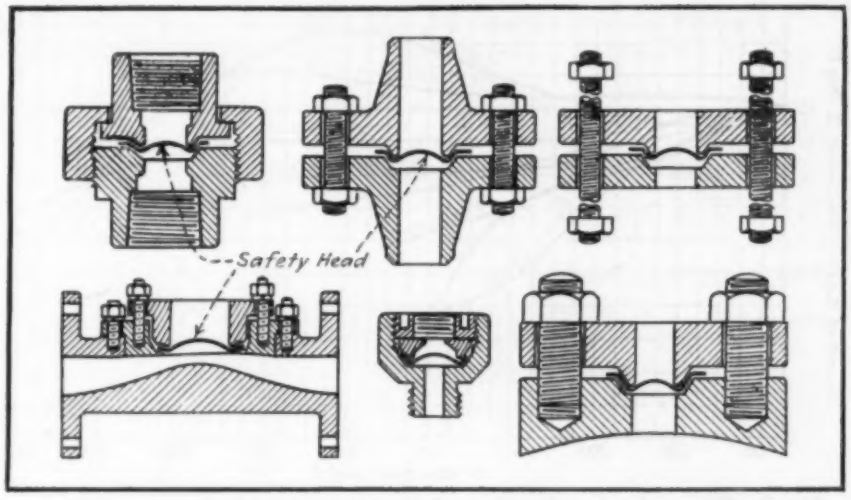


Fig. 1—Several typical Safety Head flange and diaphragm assemblies

Should the diaphragm be insufficiently rigid to resist flexing or collapsing from pressure of the atmosphere (when vacuum occurs within the vessel), then special provisions must be made. The latest design of Safety Head vacuum support is illustrated in Fig. 2. The support is rigid against loading from its convex side, but will open wide when the diaphragm ruptures, thereby presenting no obstruction to full discharge area. Ordinarily, diaphragms for bursting about 300 lb. per sq.in. and higher need no vacuum support.

DIAPHRAGM USE

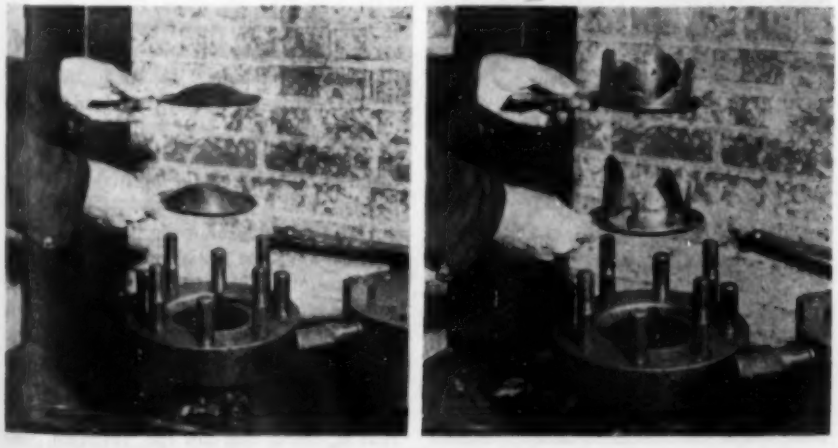
Parallel Arrangement—When equipment is to be operated at more than about 67 percent of its "allowable working pressure" (designed working pressure) it is best to place the rupture diaphragm in parallel with a relief valve, the latter used for primary relief. In this fashion the diaphragm supplements the valve providing emergency relief as in Fig. 4. Thus located, the bursting pressure can be at practically any value desired, from 50 percent above actual operating pressure up to the test pressure for the equipment. Emergency protection is provided in event of: (1) An inoperative relief valve—due to sticking, clogging, corrosion, etc., which prevents normal relief; (2) external fire or heat—causing an excessive rate of pressure generation; and (3) internal fire or a rapid exothermic chemical reaction—representing abnormal conditions which the valve is not designed to handle.

Series Arrangement—When the equipment is to be operated at or less than about 67 percent of its "allowable working pressure" (designed working pressure), it becomes practicable to use a rupture diaphragm for either normal or emergency relief, either in conjunction with a relief valve or as the only relief device. Most codes for design and operation require normal relief to commence at a point no higher than the allowable working pressure. Hence any diaphragm or other rupture device used to satisfy primary relief requirements should not be rated to rupture in excess of the stated pressure. This limitation applies whether the rupture diaphragm is used as the only relief device, or is underneath, or otherwise in series with a relief valve.

A rupture diaphragm used as the only relief device, i.e., in lieu of a relief valve, is most desirable where the need for pressure relief represents an abnormal or emergency condition. Typical applications occur in:

1. Low pressure or vacuum equipment—such as aqua ammonia storage tanks, chemical kettles, and evaporators.
2. Chemical autoclaves—where any leakage of the contents may upset desired results, and where reactions may prove dangerously violent unless excessive pressure can be rapidly relieved.
3. Heat exchangers, coolers, etc.—where a high-pressure tube section may experience a leak or other type of failure and thereby release high pressure to a low-pressure-design shell section.
4. Turbine casings—an increasingly

Fig. 2—Left view shows unruptured diaphragm, above, and vacuum support, below; view at right shows diaphragm and support after rupture



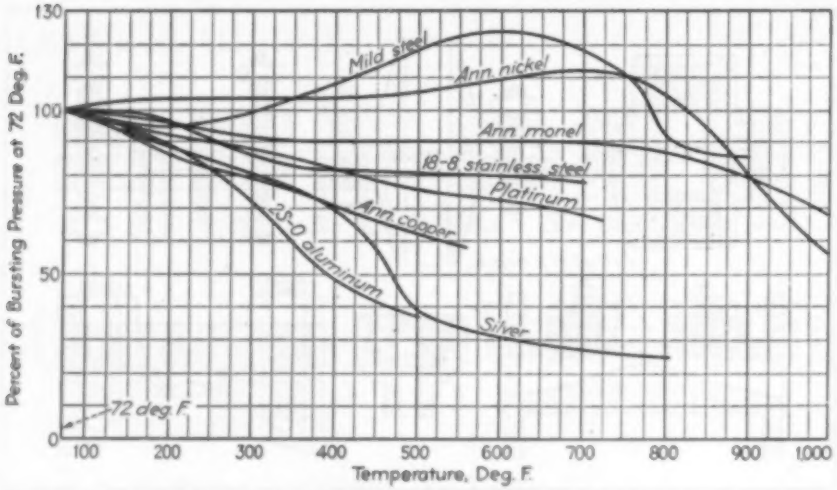


Fig. 3—Curves showing the effect of temperature on the bursting pressure of diaphragms made from several different metals

popular use, where it may happen that steam or other motive fluid will be turned into the turbine while the exhaust line is closed off.

5. Positive displacement equipment—where blocked lines or closed valves may cause excessive back pressure.

6. Gas generators and related equipment—which require large relieving capacity in event of backfire.

7. Other equipment subject to improper manual operation, capable of causing overpressure.

A rupture diaphragm installed underneath a relief valve, as in Fig. 5, serves to protect the valve against corrosive, sticking, etc., as frequently happens in various severe types of service.*

The same method may be used to prevent leakage through the relief valve of such materials as Freon, ammonia, Dowtherm, chlorine, and other fluids which are notoriously difficult to hold, or where for any reason continued leaking is to be avoided.

A rupture diaphragm may be installed above or beyond the relief valve (see Fig. 6), provided the valve is of a design which is not equalized by back pressure. This series arrangement is more desirable than the one discussed above for services such as those mentioned in the preceding paragraph, provided, however, that the fluid will not corrode, clog, or stick the valve.

Any reference to series installation of a rupture diaphragm with a relief valve applies solely to normal or primary relief requirements, in cases where the major function of the relief valve (following rupture of the diaphragm) would be to close off pressure escape after the required relief has been accomplished.

Series-Parallel Arrangement—It is often advisable in series installations to supplement the primary relief capacity with another rupture diaphragm (possibly larger), placed in parallel with the series installation, so as to provide secondary or positive emergency relief. This unit should have a bursting pressure somewhat higher than the first diaphragm, as already recommended in the section on parallel operation.

Other Uses for Diaphragms—Many rupture diaphragms are used in services where the necessary relief capacity, or even the possibility of providing for it, may be more or less problematical. Better practice is to make use of the greatest practical degree of protection in view of the conceivable or potential hazard. In most instances the object is to provide for quick venting of large volumes of gas which may be generated, or of pressure waves. Some examples are:

1. Oxygen, hydrogen, acetylene, or similar manifolds, headers, and lines in which "flashes" may occur.

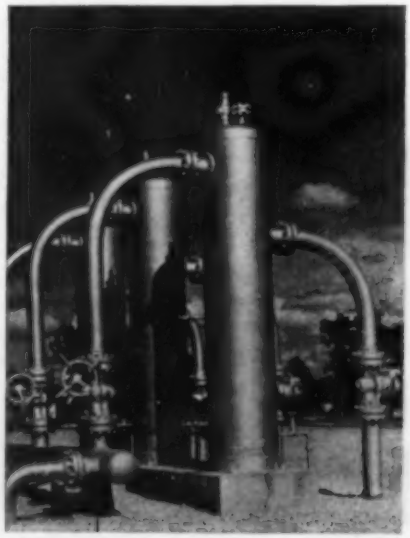
2. Compressed air lines leading from compressors to receiver tanks—due to the possibility of oil-vapor ignition at the discharge valve of the compressor.

3. Oil- or gas-filled electrical switch gear or transmission equipment, in which arcing—either expected, or experienced only from grounded or shorted conductors—may build up excessive pressures. Particularly is protection important for equipment which operates under pressure, or which for any other reason is not open-vented.

4. Pressure-indicating, metering, regulating, and related instruments and apparatus—to be protected against such over pressures in piping system.

Other definite types of applications may be recognized from their basic similarity to those already named, or from the operator's familiarity with his specific problem.

Fig. 4—These vessels are protected by a diaphragm and safety valve in parallel, at the top



SIZE SELECTION

How can the proper size of rupture diaphragm be selected for a known required relief capacity? Preferably, the rupture device assembly should represent an efficient orifice or nozzle for maximum discharge. A Safety Head diaphragm opens to the full bore of its holding flanges, which in turn provide a discharge area equal or greater than that of the connecting pipe or neck.

In any discharge calculation a discharge coefficient applying to the type of orifice or nozzle in question must be used. Since a Safety Head assembly that is ruptured is similar to the short-tube type of orifice, a coefficient of 0.81 is taken as a conservative figure for gases, and 0.61 for liquids. The use of these coefficients with well-known standard formulas will ordinarily permit a sufficiently accurate determination of the discharge.

In rather long runs of piping to or from the rupture device, or where changes in direction, etc., of such piping are encountered, it may be necessary to calculate the pressure drop and flow to be expected through the piping. In such cases the opening through the Safety Head flanges can be taken as at least equal to the bore of the connecting piping. Reference is made later to discharge of highly viscous liquids.

Gases—In the following it is assumed in all cases that the initial or upstream absolute pressure is at least twice the absolute pressure to which discharge occurs. This results in the maximum rate of discharge obtainable for that initial pressure, regardless of how much the downstream pressure may fall below the "critical" condition, that is, below one-half the upstream pres-

* In its addenda of Aug. 25, 1944, to the unfired pressure vessel code, the A.S.M.E. Boiler Code Committee permits certain uses of rupture diaphragms in meeting the pressure relief requirements of the code. One of the provisions of the addenda is that when a diaphragm is used between the protected vessel and a safety valve, the space between the diaphragm and the valve shall be provided with a pressure gage, try cock or free vent to indicate whether the diaphragm has leaked or burst.

Table II—Relieving Capacities of Safety Heads of Various Sizes for Various Bursting Pressures

(Based on calculated values, not actual tests, in discharging 0.6 sp.gr. natural gas at 60 deg. F.; to calculate relieving capacities for air, multiply by 0.788)

Bursting Pressure, Lb. per Sq. In. Ga.	Relieving Capacities, Cu.Ft. of Free Gas at 1 Atm. and 60 Deg. F., per Min. — Nominal Diaphragm Diameter, Inches *											
	0.5	1	1.5	2	3	4	6	8	12	16	20	24
25					5,660	9,750	21,900	38,300	85,800	135,000	212,900	307,900
50				4,170	9,200	15,800	35,600	62,000	139,000	220,000	346,000	500,000
100	425	1,700	3,840	7,300	16,000	26,800	62,000	108,000	243,000	384,000	603,000	870,000
150	620	2,500	5,620	10,600	23,400	40,400	91,000	158,000	356,000	562,000	880,000	1,280,000
200	810	3,260	7,300	13,900	30,600	52,800	118,000	207,000	464,000	730,000	1,150,000	1,670,000
300	1,190	4,780	10,700	20,400	44,900	77,000	174,000	304,000	660,000	1,070,000	1,690,000	2,220,000
400	1,560	6,300	14,100	26,900	59,000	102,000	229,000	400,000	900,000	1,410,000		
500	1,950	7,800	17,500	33,300	73,000	126,000	284,000	496,000	1,010,000	1,590,000		
600	2,320	9,300	20,900	39,800	87,000	151,000	339,000	592,000	1,200,000	1,900,000		
700	2,700	9,900	24,400	40,700	91,000	158,000	360,000	630,000				
800	3,080	11,300	27,800	46,400	104,000	181,000	410,000	720,000				
900	3,460	12,700	31,200	52,000	116,000	203,000	460,000	806,000				
1,000	3,840	14,100	34,700	57,800	129,000	225,000	512,000	890,000				
1,200	4,600	16,800	41,500	69,000	155,000	270,000	610,000	1,070,000				
1,400	4,670	14,200	38,400	61,000	148,000	253,000						
1,600	5,330	16,300	43,800	70,000	169,000	290,000						
1,800	5,990	18,200	49,200	78,000	190,000	325,000						
2,000	6,700	20,300	54,700	87,000	210,000	360,000						
3,000	10,000	30,400	82,000	130,000	315,000	540,000						
4,000	13,300	40,500	109,000	174,000	420,000							
5,000	16,500	50,500	136,000	217,000	525,000							
6,000	19,900	60,000	163,000	260,000	630,000							

* Safety Head flanges above the single line have I.D. equal to that of Schedule 40 pipe; those between the single and double lines, Schedule 80 pipe; and those below the double line, Schedule 160 pipe.

sure. This fact, commonly known, is made a basis for the remaining discussion, since metal rupture diaphragms are hardly practical at present, owing to extreme thinness, if made for a rupture pressure less than 15 lb. per sq.in. ga. (or for bursting at any other pressure which is less than 15 lb. above the downstream pressure). The minimum bursting pressure for relief to atmosphere is therefore about 15 lb. per sq.in. ga.

Table II gives a tabulation of relieving capacities for natural gas[1] discharged from free-vented Safety Heads (without piping beyond), and a correction factor for air. Values are based upon discharge from 60 deg. F., and expressed in cubic feet per minute of free gas at atmospheric pressure (14.7 lb. per sq.in. abs.) and 60 deg. F. Values were calculated from Equation (1), using a coefficient of 0.81.

A number of long-established formulas are to be found for adiabatic discharge of gas or vapor, of which several of the more useful are shown below.

For any gas or vapor behaving approximately as a perfect gas:[2]

$$W = CA\left(\frac{2}{n+1}\right)^{\frac{1}{n-1}}\sqrt{2g\left(\frac{n}{n+1}\right)\frac{P_1}{V_1}} \quad (1)$$

where W = pounds discharged per second; C = discharge coefficient = 0.81 for a free-vented Safety Head; A = orifice area in sq.ft.; n = ratio of specific heats = C_p/C_v; g = acceleration of gravity, ft. per sec.^{2}; P_1 = upstream pressure, lb. per sq.ft., abs.; and V_1 = specific volume, cu.ft. per lb., at P_1.

In slightly different form, we have:[3]

$$W = CAP_1\sqrt{\frac{gnM}{1{,}543\,T_1}\left(\frac{1+n}{2}\right)^{\frac{1+n}{1-n}}} \quad (2)$$

where M = molecular weight of the perfect gas; T_1 = temperature of the gas before discharge, at P_1 in deg. F. abs. = 460 plus thermometer reading; and A = sq.ft. or sq.in. when P_1 = lb. per sq.ft. abs., or lb. per sq.in., abs., respectively.

Air—Applying n for air = 1.405 in Equations (1) and (2) above, and substituting in Equation (1) RT_1/P_1 for V_1 (from the gas laws, taking R for air = 53.3), it is found that both Equations (1) and (2) reduce to Fleigner's formula, which is

$$W = 0.53\,CAP_1/\sqrt{T_1} = \text{Lb. air per sec.} \quad (3)$$

For convenience, A is taken in sq.in. and P_1 in lb. per sq.in. abs.

Steam—For initially dry and saturated steam, Napier's formula is commonly used, and is:

$$W = CAP_1/70 = \text{Lb. steam per sec.} \quad (4)$$

Symbols are the same as in Equations (2) and (3).

Emswiler[4] states that for superheated steam, W should be multiplied by $1/(1 + 0.00065D)$, where D is superheat in degrees F. Where the steam is initially wet, he advises that W should be multiplied by $1/(1 - 0.012M)$, where M is number of percent of moisture.

Petroleum Vapors—The A.P.I.-A.S.M.E. Joint Code for unfired pressure vessels requires that discharge capacity of relief devices shall be computed by the following formula (coefficient inserted by author):

$$W = 306\,Cap\sqrt{M/T} \quad (5)$$

where W = discharge in lb. per hour; a = effective orifice area, sq.in.; p = initial pressure, lb. per sq.in. abs.; M = molecular weight of the vapor; and T = initial temperature, deg. F. abs.

For comparative rates of discharge between various gases, rough approximations at least can be obtained from the following relationships:

1. Velocities of discharge of two gases from same initial pressure vary inversely as

Fig. 5—Two methods of mounting the Safety Head before the safety valve, for valve protection

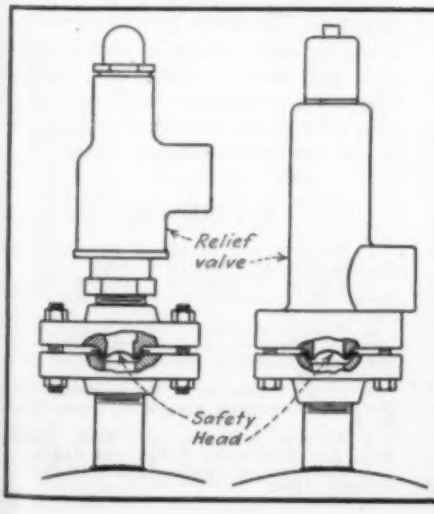
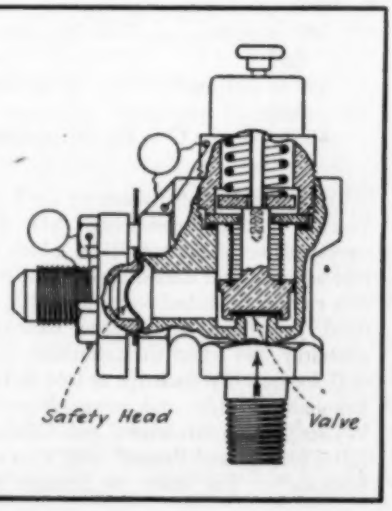


Fig. 6—Safety Head located after a relief valve of a type which is unaffected by back pressure



the square roots of their respective initial densities.

2. This also applies when molecular weights are substituted for initial densities, provided that initial temperatures (for the gases compared) are identical at the initial pressure.

3. The volumes discharged vary as in (1) and (2).

4. The weights discharged vary directly as the square roots of the densities of the respective gases; or as the square roots of their molecular weights, provided that the initial temperatures are identical.

Liquids—Because of the incompressibility of liquids, calculation of the rate of discharge through an orifice or nozzle (such as a Safety Head) is relatively easy as compared to gases. Exceptions may exist for highly viscous or adhesive liquids, and some consideration is given the subject later in this article.

(It should be recalled in considering a proposed rupture disk installation that rate of discharge of a liquid is much less volumetrically than that of a gas. Where pressure must be relieved from a system containing both liquid and gas, much faster relief is to be had by locating the rupture device in the gas-filled zone.)

The basic function of an orifice is the conversion of potential energy into kinetic energy. Except for the unavoidable retarding effects of fluid friction and viscosity, the potential energy of a column or head of liquid standing above the orifice level is completely converted into kinetic energy in discharging *freely* from the orifice, against no back pressure. Since the velocity of discharge is a function of the kinetic energy, the velocity can be determined by setting the kinetic energy value equal to the liquid head, after which the rate of quantity discharge is determined from the velocity and the area of the orifice.

CALCULATING DISCHARGE

The velocity and rate of discharge so indicated are correct only for ideal conditions, and are always modified in practical cases by certain factors which exert themselves to a greater or lesser extent, depending upon the specific nature of the reservoir, orifice, liquid, etc. These are briefly described later herein, and are represented collectively by the coefficient C in Equation (6).*

The basic formulas for liquid discharge are

$$V_{av} = C\sqrt{2gh} \qquad (6)$$

and

$$Q_{av} = V_{av}A \qquad (7)$$

and where $V_{av.}$ = average velocity, ft. per sec., over orifice cross-section; C = velocity coefficient, over orifice cross-section; g = acceleration of gravity, ft. per sec.^{2} (taken as 32.0); h = height of liquid above orifice, ft. (considered constant); $Q_{av.}$ = volume of liquid discharged, cu.ft. per sec. (or lb. per sec. when $Q_{av.}$ is multiplied by lb. per cu.ft.); and A = orifice area, sq.ft.

If gas (or vapor) pressure is exerted on the surface of the liquid (as in many pressure vessels), the combined equivalent head must be used in calculating the velocity. Gas pressure can be transposed into equivalent liquid head from:

$$h = 144P/\rho \qquad (8)$$

where P = pressure above the liquid (in lb. per sq.in. ga., for liquid discharge problems); and ρ = density of liquid, lb. per cu.ft.

EFFECT OF VISCOSITY

If we consider as a basically representative condition a large reservoir discharging freely through a short-tube orifice, so that the velocity within the reservoir is negligible and the liquid head falls slowly—then the overall velocity coefficient C will be approximately 0.61, or less if liquid is very viscous.[5]

Viscous Liquids—From reference sources already suggested, it is easy to determine the viscosity for the commoner liquids at the existing temperature. Otherwise viscosity may be found by standardized experimental means. It will be noted that the viscosity effect on flow is reflected by the Reynolds number, which is:

$$Re = DV_{av}\rho/\mu \qquad (9)$$

where Re = Reynolds number for the orifice, pure number; D = orifice diameter, ft.; ρ = liquid density, lb. per cu.ft.; and μ = viscosity, lb. per sec.-ft. = visc. in centipoises $\times$ 0.00067.

It will be seen that the Reynolds number depends upon $V_{av.}$ in spite of the fact that it is to determine $V_{av.}$ that the Reynolds number is used. Therefore, for approximation purposes, it is suggested that $V_{av.}$ first be calculated, using C as 0.61; then if $V_{av.}$ so determined results in a value of Re of about:

- 200 or higher, use C in Eq. (6) as 0.61
- 100 to 200, use C in Eq. (6) as about 0.50
- 50 to 100, use C in Eq. (6) as about 0.40

The values suggested above are not based directly on any experimental data truly representative of the conditions which are here assumed, nor does it appear that such data exist in published form, if at all. Instead, the values were taken somewhat arbitrarily, and reflect the asymptotic value of C for quantity discharge as 0.61 at high Reynolds numbers, and curves shown by Walker, Lewis, McAdams and Gilliland[3] (after Stanton and Pannell[5], and Tuve and Sprenkle[6]). The study by Stanton and Pannell shows values of $V_{av.}/V_{max.}$ against different Reynolds numbers for flow in circular pipe, and gives $V_{av.}/V_{max.}$ equal to only 0.5 for Reynolds numbers less than about 2,000. The work of Tuve and Sprenkle is based on sharp-edged orifice flow, plotted against Reynolds numbers.

Should a proposed application require that some considerable length of vent piping be used beyond the rupture disk, then for very viscous liquids it is wise to calculate the pressure drop or friction head loss in the piping. Reference to hand books and texts will show that this is dependent upon the friction factor f. From charts which show values for f, application can be made to the Fanning equation, which is:

$$h_f = 2fNV^2/gD \qquad (10)$$

where h_f = friction head loss in piping, ft. of liquid head; f = dimensionless friction factor; N = actual length of straight pipe, or equivalent length of pipe, plus fittings and their effect, ft.; V = average linear velocity through pipe, ft. per sec.; and D = inside diameter of pipe, ft.

It is seen above that since flow or discharge is assumed as due to a constant liquid head in the reservoir, the actual velocity will be less as a result of the friction loss. It is suggested, therefore, that the average velocity initially calculated (before determining the friction loss) be used in Equation (10) above; after which h_f should be deducted from the initial head to obtain the effective working head, h_e, i.e.:

$$h_e = h - h_f \qquad (11)$$

By substituting h_e for h in Equation (6) and using the appropriate value for C (as corrected for viscosity), the resulting effective velocity can be calculated, and hence the quantity rate of discharge.

(Even more important than the subjects attacked in this article is the question of determining the required relief capacity for various classes of vessels. A second article by Mr. Murphy, to appear in an early issue, will discuss the various ways in which overpressure can occur and will describe the peculiarities of several types of system. The article gives sample calculations for relief capacity in several typical cases and offers a number of simplified rules and generalizations that should be of great value in the solution of pressure protection problems.—*Editor.*)

REFERENCES

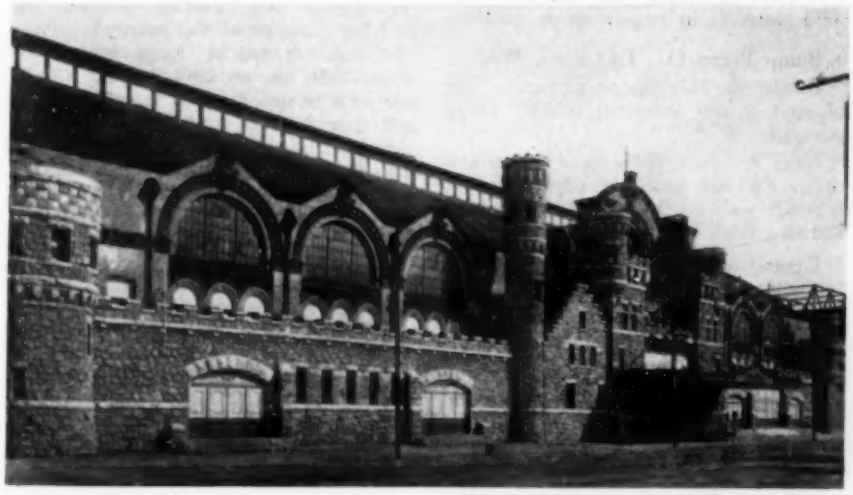
1. From Black, Sivalls & Bryson, Inc., Catalog No. 42, "Safety Heads."
2. Walker & Crocker, "Piping Handbook," McGraw-Hill Book Co., Inc., New York, N. Y.
3. Walker, Lewis, McAdams and Gilliland, "Principles of Chemical Engineering," McGraw-Hill Book Co., Inc., New York, N. Y.
4. J. E. Emswiler, "Thermodynamics," McGraw-Hill Book Co., Inc., New York, N. Y.
5. Stanton and Pannell, *Phil. Trans. Roy. Soc.* (London), A 214, 199 (1914).
6. Tuve and Sprenkle, *Instruments*, November, 1933.

* Before attempting to make close calculations for orifice size, etc., one should at least be acquainted with the subject to the extent available from reference to the recognized handbooks on piping, mechanical or civil engineering; and to the thermodynamics texts, etc.

SPOTLIGHT ON EQUIPMENT

At Chicago's Third Biennial Chemical Show

When this copy of *Chem. & Met.* reaches its readers the Third National Chemical Exposition will have come to a close in Chicago. The number of exhibitors was greater by over a half than the Show in 1942 and indications are, as this report is written shortly before the doors open, that attendance will be much larger than before, possibly even approaching that of New York Chemical Expositions.—*Editors*



Chicago Collseum made available twice the space of the 1942 Exposition

For the third time, Chicago has demonstrated that the Middle West wants and can justify a Chemical Exposition. During the five days, Nov. 15-19, the Third National Chemical Exposition was held at the Chicago Coliseum under the auspices of the Chicago Section of the American Chemical Society. More than 160 exhibitors had space at the 1944 Exposition, as compared with slightly over 100 at the second Exposition of 1942.

The New York Expositions have always presented a certain number of educational features in addition to the Exposition proper, but the Chicago Show has, wisely, it appears, emphasized an extensive and well worked out program in addition to the exposition features. The concurrent meetings, presented at the National Industrial Chemical Conference, also sponsored by the Chicago Section, offered daily programs as well as luncheon and dinner functions.

In addition to the regular exhibits, the Show featured a comprehensive series of industrial motion pictures, of which there were nearly 30. These films, projected in a substantially continuous program during the Exposition, dealt with such subjects as metals, plastics, abrasives, explosives, pharmaceuticals, synthetic rubber, petroleum products and blood plasma. Besides the motion pictures there were educational exhibits dealing with the newer forms of the electron microscope as well as the industrial use of high frequency power in the generation of heat.

Breaking the exhibits down roughly into four major classifications, 103 showed plant-scale equipment, instruments and construction materials; 23 emphasized laboratory equipment; 26 exhibited chemicals, plastics and allied products; and 9 were publishers, associations and institutions.

(Since it was necessary to prepare this report in advance of the exposition, we are able only to describe the exhibits of those manufacturers who supplied us with information. Since this is intended as an equipment review, no effort was made to contact exhibitors showing chemicals and allied materials, nor publishers.—*Editor*)

American Foundry Equipment Co., Mishawaka, Ind.

Exhibited: This company's Dustube cloth bag type dust collectors, using cutaway unit which clearly revealed the simplicity of operation and high dust collecting capacity of the unit.

American Photocopy Equipment Co., Chicago 14, Ill.

Exhibited: Machinery for producing photocopies of letters, drawings, blueprints, etc., as well as paper and supplies for use in the process.

H. Reeve Angel & Co., New York, N. Y.

Exhibited: Industrial and laboratory filter papers and filtering materials.

Automatic Transportation Co., Chicago, Ill.

Exhibited: Models of its electric-powered Transporter, a front-wheel-drive motorized hand truck with hydraulic lift platform for skids, or supplied with forks for lifting pallets. These units are designed for short hauling of loads, either on skid platforms up to 6,000 lb. weight or on pallets up to 4,000 lb.

Barrett-Cravens Co., Chicago 23, Ill.

Exhibited: This company's entire line of materials handling and storage equipment, including lift trucks, skids, hoists, portable elevators, portable cranes, storage racks, platform trucks and so on.

New: Two new electrically driven lift trucks were shown, the PowerOx, which is a standard type lift truck with an electric drive; and the PalletOx, which is an electrically driven pallet type lift truck.

Bemis Bro. Bag Co., St. Louis 2, Mo.

Exhibited: Aquatex closures for bags; and multi-wall paper bags. The new waterproof closure is being used at present extensively in overseas shipment to the armed forces. A waterfall exhibit showed the waterproofness of this company's multi-wall bags after they had been subjected to continuous submersion in water for a 24-hour period. The exhibit also demonstrated bag closing using actual equipment in operation.

New: The Aquatex closure for multi-wall paper bags is a recent development.

Brown Instrument Co., Philadelphia, Pa.

Exhibited: Several new electronic industrial instruments as well as pneumatic control systems for chemical processes. The instruments shown included an electronic potentiometer recorder said to be unaffected by severe vibrations, a pneu-

matic circular-chart controller of the electronic type; a precision central-reading indicator; a single-record high-speed electronic potentiometer; and a multiple-record electronic potentiometer for pH recording and similar uses.

New: All of the instruments shown are of recent design.

Buffalo Foundry & Machine Co., Buffalo, N. Y.

Exhibited: This company's latest type of laboratory size vacuum double-drum dryer which is intended primarily for the drying of heat sensitive liquids containing solid materials in suspension or solution.

Bump Pump Co., La Crosse, Wis.

Exhibited: This concern's complete line of sanitary and industrial positive rotary pumps.

New: A new variable-speed pump was shown, and new small high-pressure pump, together with a new unit for mixing and agitating small quantities of liquids.

Central Scientific Co., Chicago, Ill.

Exhibited: A complete line of photoelectric photometers for spectroscopic analysis and other purposes.

Chicago Pump Co., Chicago, Ill.

Exhibited: A scale model of this company's wide-band air diffusion system in operation, demonstrating the ability of this process to provide a high degree of efficiency in oxygenation and mixing, applied to microbiological and chemical processes.

The Container Co., Van Wert, Ohio.

Exhibited: This company's full line of fiber shipping drums as well as several specialties. The company's original fiber drum, the Stapak, is said to obtain exceptional strength and rigidity through the use of all sulphate kraft fiber for the side walls. The drum has a full opening head and baked enamel top and bottom with a sealing lug closure. The company's strongest drum, the Fiberpak, is produced in sizes from ¾ to 67 gal. capacity. It is available with various special treatments for the handling of a wide range of special products. The Leverpak drum, another member of the family, is made in sizes from 15 to 75 gal. capacity. It employs a special sift-proof cover held in place by an easily operated lever type locking band, and uses a reinforced bottom supported by a heavy metal chime.

New: This exhibitor showed a new fiber grease drum with metal ends, employing special proofing to prevent any penetration of the grease into the side walls and to eliminate chime leakage.

Corning Glass Works, Corning, N. Y.

Exhibited: A variety of industrial glassware, including a glass pump, a plug-cock valve, a rotameter, industrial glass pipe and fittings, industrial ware, precision finished ware and Vicor 96 percent silica industrial ware. Also shown were new developments in laboratory glassware including a fractional distilling apparatus for use where only small quantities of liquids are available. Other items included a full line of ball and socket joints and standard tapered joints as well as a variety of special products such as fritted ware, low actinic ware and 96 percent silica glassware.

F. M. deBeers & Associates, Chicago 6, Ill.

Exhibited: Products of client companies including American Heat Reclaiming Co., Croll-Reynolds Co., Cross-Reynolds Mfg. Co., Fletcher Works, Goslin-Birmingham Mfg. Co., and General Ceramics Co. Included in the exhibit were a large spiral heat exchanger made by the first mentioned company. A special acid-resisting multi-stage ejector produced by the second was another feature. A Fletcher commercial size suspended type centrifugal of special design for drying pecan shells was on display, along with a complete ceramic-ware kettle with agitator and drive, built of a new temperature resisting ceramic, produced by General Ceramics Co. The latest type of high velocity multiple-effect evaporator built by Goslin-Birmingham Mfg. Co. was demonstrated by means of an illuminated backdrop.

The DeLaval Separator Co., New York 6, N. Y.

Exhibited: Centrifugal separation equipment shown both by means of drawings and by actual equipment in the case of some of the smaller types. Included were such devices as industrial separators, the company's Uni-matic oil purifier and a precision test tube centrifuge.

The Dicalite Co., Los Angeles, Calif.

Exhibited: Combined pictorial and physical exhibits showing the extent of the company's manufacturing and research facilities, engineering service, and the materials manufactured. Included were various products produced from diatomaceous silica including filter aids, fillers, high temperature insulation, absorbents, catalyst carriers, admixtures, etc.

New: New uses for Dicalite were indicated in catalyst carriers and in water purification. Two grades are available for the purification of steam condensate. Another filter aid material is being provided to the armed forces for filtering water which has been chemically treated prior to use in drinking or cooking. This material is believed by the manufacturers to have future possibilities in public water supplies for localities where water must now be brought considerable distances.

The Dorr Co., New York 22, N. Y.

Exhibited: A small-scale de-ionization unit for producing water equivalent to distilled water in quantities from 2 to 17 gal. per hour, but comparable in principle and operation to the company's industrial units, having capacities up to 900 gal. per hour. In addition to this demonstration equipment, the company displayed large photographs tied in with animated flow diagrams illustrating several processes using this company's equipment, including wet-process cement manufacture, recausticizing in the production of kraft pulp, the recovery of phosphate rocks fines and the purification of water for chemical plants.

The Duriron Co., Dayton 1, Ohio.

Exhibited: A number of this company's products in high-silicon iron and stainless alloys, including pumps, valves and fittings.

As in the 1942 Exposition, a portion was divided between the exhibits

Eutectic Welding Alloys Co., New York, N. Y.

Exhibited: This company's methods and welding rods for low-temperature welding of all industrial metals, for fabrication, maintenance and repair.

Fisher Scientific Co., Pittsburgh, Pa.

Exhibited: New apparatus and chemicals permitting precise control of manufacturing in war plants, providing means for safeguarding military and civilian health, and facilitating inspection and research. Many instruments were shown for various methods of analysis including titrimeters, electrophotometers and dropping mercury electrodes.

General Ceramics Co., Keasbey, N. J.

Exhibited: A variety of products in chemical stoneware and chemical porcelainware, including a large tower for reaction or absorption, a ceramic heat exchanger with metal body and stoneware tubes and standard pieces of stoneware equipment including pumps, tanks and piping.

New: Several new designs were exhibited, including a new type of HCl absorption apparatus and a new line of acidproof cements.

Graver Tank & Mfg. Co., East Chicago, Ind.

Exhibited: Water treating equipment shown by photographs and drawings, for the production of substantially demineralized water, together with a Lucite model of this company's clarifier, graphically illustrating the working principle.

of which is shown here, the interest of chemicals and of equipment

Gray-Mills Co., Evanston, Ill.

Exhibited: A line of pumping units, fractional horsepower pumps and a fluid cooling system.

Great Western Mfg. Co., Leavenworth, Kan.

Exhibited: A complete line of this company's Combs gyratory sifting and screening machines for dry, liquid and semi-liquid materials, shown in both batch and continuous designs.

New: This exhibitor showed for the first time the Super Syfon feeder and separator for use on hammermills for removing scrap iron and non-magnetic materials from free flowing and semi-free flowing grains and other products.

D. W. Haering & Co., Chicago, Ill.

Exhibited: Water treating chemicals and equipment for the control of corrosion, scale, algae and similar problems. The display included proportioning equipment for feeding the treating chemicals and made available data on the proper water conditioning applicable to petroleum and synthetic rubber, chemicals manufacturing in general, and other industries.

W. A. Hammond Drierite Co., Xenia, Ohio.

Exhibited: Drying agents and special equipment and devices for the drying of solids, liquids and gases, especially featuring industrial equipment for the drying of gases and organic liquids. One of the company's standard two-tower drying units was on display.

Hills-McCanna Co., Chicago 18, Ill.

Exhibited: This company's diaphragm-closed (Saunders patent) valve for air, water and chemicals; proportioning pumps of various types; forced feed lubricators; and magnesium alloy castings.

Illinois Electric Porcelain Co., Macomb, Ill.

Exhibited: Chemical porcelain ware applied to a variety of products including pipes, valves, fittings and special pieces developed for the chemical industry.

New: A porcelain propeller for agitation, believed by the manufacturer to be one of the first of its type, was on display.

Infra-Red Engineers & Designers, Cleveland, Ohio.

Exhibited: Equipment for drying, employing infra-red radiation, including a vibrating conveyor type oven for powders and granules, equipped with automatic temperature control; and a sectional-insulated reflective infra-red oven unit of elliptical type.

Johns-Manville Corp., New York, N. Y.

Exhibited: Sorbo-Cel, a high-flow-rate filter aid material used for removing oil from steam engine condensate prior to return to boilers.

The Johnson Corp., Three Rivers, Mich.

Exhibited: A piece of demonstration equipment showing this company's rotary pressure joint in operation on a rotating drying cylinder, as well as cutaway models of other equipment made, including an electric boiler return trap, an instant steam water heater and a compressed air separator and aftercooler.

Walter Kidde & Co., New York 6, N. Y.

Exhibited: Carbon dioxide fire fighting equipment, including a typical cylinder set-up as used for industrial installations; various types of portable extinguishers; various types of fire detectors and other auxiliary equipment; and a Kodachrome sound film showing the fighting of the three classes of fires. The latter is available on loan.

Kimble Glass Co., Vineland, N. J.

Exhibited: A representative line of laboratory glassware for research, analysis and control.

Kold-Hold Mfg. Co., Lansing, Mich.

Exhibited: A new 5-cu. ft. low-temperature cabinet operating at —150 deg. F. and intended especially for use in chemical and metallurgical laboratory work.

Laboratory Furniture Co., Long Island City 1, N. Y.

Exhibited: Laboratory furniture, including a fume hood, balance table, storage cabinet and microscope table, with illustrations of important laboratories that have been supplied by this concern.

Lapp Insulator Co., LeRoy, N. Y.

Exhibited: Various items of chemical porcelain ware, including a 1-in. porcelain pipeline under pressure, having joint faces polished optically flat and assembled without gaskets; as well as porcelain valves of various types including safety valves, flush bottom valves, quick opening and armored valves.

New: A new porcelain supporting plate for Raschig rings, offering twice the free space available in standard drilled or slotted diaphragms. Also, a new line of porcelain plug cocks.

Leader Iron Works, Inc., Decatur, Ill.

Exhibited: Enlarged photographs of special equipment built by this concern, including fractionators, heat exchangers, special kettles and pressure vessels, together with photos and samples of welded commercial metals and alloys.

Loeb Equipment Supply Co., Chicago 22, Ill.

Exhibited: Stainless steel steam jacketed kettles, bottle fillers and other equipment including portable electric mixers and stainless steel filters manufactured by the Alsop Eng. Corp. of Milldale, Conn.

Lukens Steel Co., Coatesville, Pa.

Exhibited: Three motion picture films in Kodachrome including a sound film dealing with the spinning and pressing of heads by this company; a silent film showing the manufacture of this company's nickel-clad and Monel-clad steels; and a second silent film showing the casting of a 110,000 lb. ingot and its subsequent rolling on this company's 206-in. plate mill, said to be the world's largest.

Merco-Nordstrom Valve Co., Pittsburgh, Pa.

Exhibited: This company's complete line of lubricated plug valves, emphasizing special alloys and illustrating principles with cutaway models showing the Sealdport method of valve lubrication. Among the valves shown were some using the recently developed Merchrome coating, a method of hard facing whereby contact surfaces are made suitable for use under extreme conditions of corrosion and erosion. This company's affiliate, Pittsburgh Equitable Meter Co., displayed industrial instruments for the measurement of gas, air, oil and other commodities.

Mine Safety Appliances Co., Pittsburgh, Pa.

Exhibited: A wide variety of products and instruments for personnel and plant protection, including gas and dust detecting and analyzing devices, protective clothing and respiratory protective equipment.

National Carbon Co., New York, N. Y.

Exhibited: A new Karbate pump in operation showing the method of connecting the pump to a Karbate pipeline with various types of joints, with Karbate globe valves, expansion joints, elbows, etc. Karbate plate type heat exchangers, bayonet type heaters, polygonal segmental type tower sections and a variety of carbon and graphite products were displayed.

New: The Karbate pump and various other items including the plate type heat exchanger, bayonet type heaters and a new Van Stone joint are all recent.

National Technical Laboratories, South Pasadena, Calif.

Exhibited: pH equipment including portable pH meters, automatic pH indicating and recording equipment and a variety of electrodes. Also spectrophoto-

(*Continued on page 137*)

FROM THE VIEWPOINT OF THE EDITORS——

YOUR CUSTOMERS' PLANS

Postwar programs of customers are now of immediate interest to the producers of chemicals. Sales organizations are beginning to talk with buyers about their future needs. Perhaps the order book is not yet an important part of these conferences but pencils are being sharpened and fountain pens are available if needed.

Many manufacturing firms are well along in their programs for postwar production. Actual operations may not have begun but they will start promptly when the break occurs in the barrier on the movement of civilian goods. This means that the firms which will supply raw materials must also be getting ready so that there will be no delay in the chain of production.

Here is an opportunity for the exchange of technical information of mutual interest. The maker of chemicals must know about the prospective needs of his customers even when they relate only to the standard commodities of commerce. It is even more important when the new manufacturing may require a product of slightly different standard or quality than that previously used.

Manufacturers may naturally appear to be rather secretive about their future plans. The competitive situation in industry makes this necessary even though the Department of Justice may sometimes think otherwise. There is no law against discussion of plans between producers and sellers of raw materials. Such discussions are more than ever necessary now.

KEEP HIGH-COST OPERATIONS?

Mining interests and mine unions are pressing the Congressmen and Senators from their districts to continue federal subsidies into the postwar period. The argument is to maintain employment in these regions irrespective of the economics of the situation. It begins to look as though some of the rarer minerals and several of the metals are likely to receive the same kind of aid as has long been given to silver.

Users of copper, lead and zinc, as well as many processors of scarcer minerals and metals, will be confronted with a difficulty in this connection. If the proposed plan prevails, there will inevitably be higher prices continued beyond the war period for all of the goods for which sufficient political pressure can be so developed. It becomes, therefore, an important question for users of the ultimate products of these divisions of the mining industry to decide what they are going to do about this with *their* legislators.

The matter is not one of partisan politics. It is a matter of Western mining-state bloc operations. Those who do not think well of previous activities of this group must promptly consider how to offset them. Those who want to support the movement will have no difficulty in doing so either with the union or with the mine-owners' groups.

It appears to impartial observers (if there are any), that the mine subsidy proposals are much too extensive to be justified. But opposition to all of them may not be equally unjustifiable.

MORE FACTS AND FIGURES

International movement of chemicals must increase largely after V-E Day. This is true of chemical imports as well as chemical exports. It applies equally to raw materials used by the chemical-process industries.

Fortunately both the State Department and the Commerce Department sense the importance of these matters with respect to chemical goods. It is hoped and expected that these two departments will cooperate actively in gathering needed facts from abroad and distributing them effectively and promptly in the United States. These operations are not always easy. There is some natural resistance abroad to the effort of our American representatives to get the facts we need most. There is grave difficulty when those who obtain, transmit, and republish the facts are not technically competent to understand and handle them with complete accuracy.

All in chemical industry will hope that the two departments may effectively cooperate in order to build the best possible factual basis on which permanent international dealings in chemicals and related products and raw materials may be carried on.

THE JOB OF THE TECHNICAL INSTITUTE

Technical institutes are fast becoming an important part of the educational system of this country. Yet most of us in chemical engineering have not recognized them or known as much as we should about their service possibilities.

The technical institute trains a technician, that is, a specialist who is an assistant or aid to a professional man in science, engineering, medicine, or similar field. It usually takes boys who have graduated from high school, even some who have had a bit of college training, keeps them for two or three years, and turns them out as highly trained specialists.

In postwar education there will be a real need for this type of training. It fills a gap that has long existed between the artisan-training or craft schools and the colleges or universities which turn out degree men who can later qualify for full professional standing. Many of the technical institutes of the country have accepted very high standards as to both their financial and their educational responsibilities. They are helping admirably to

bridge the gap between non-technical and technical jobs. They deserve support and encouragement.

Many chemical engineering enterprises will welcome a steady flow of technicians to aid in design, operation, and research. There is a real place for the young man who, for some reason or other, may not be able to go through a complete degree course in chemical engineering, but who has both the talent and resources to get a certificate from a first-class technical institute.

It may well be that within a few years our personnel officers will go to these technical institutes to recruit technician assistants for chemical engineers just as they now visit the universities in search of college graduates for the full professional jobs. The important consideration is that both those who train these young people and those who hire them must recognize that there are two classes of technical workers and that the training of each should be made appropriate for their different responsibilities in the chemical process industries.

NO SNAP JUDGMENTS WANTED

As THIS is written, before the report of the well qualified fact-finding committee appointed by Mayor Frank J. Lausche of Cleveland, evidence is not complete on the causes of the disastrous and spectacular East Ohio Gas Co. fire. About all that is obvious now is that great damage to property and heavy loss of life occurred from a fire which was carried over a half square-mile area by liquefied natural gas, escaping in some manner not yet clear from two of the four large containers in which it was stored.

The East Ohio liquefied natural gas storage plant in Cleveland was described in our issue of January 1941. It consisted of refrigeration equipment for liquefying natural gas at a temperature of −257 deg. F., and storing it at substantially atmospheric pressure in four heavily insulated containers, three of them spherical, each holding 50,000,000 cu. ft. of free gas; the fourth, cylindrical, with a 90,000,000 cu. ft. capacity. Each tank was surrounded by a high concrete dike and all drained any overflow to a large underground sump. Without warning, shortly after 2 p.m. on October 20, something went awry and in a matter of seconds "flames were everywhere," liquefied gas was coursing through the streets, flowing into sewers and producing secondary explosions over a wide area.

Eye witness accounts differ considerably, some claiming that an explosion was the first occurrence, others that a cloud of vapor appeared initially, pouring out of the cylindrical storage tank before a sudden rush of fire seemed to fill the air. The fact remains that two of the four tanks were relatively undamaged and held their contents in spite of the conflagration raging around them, while an ordinary water-sealed gas holder near by, one-third full, was also damaged little. Furthermore, the two containers which were destroyed were buckled, bent and melted by intense heat, but appear not to have been blown apart by any major explosion.

The committee's report quite possibly will be made public before this magazine appears, so that it would be neither profitable nor proper to attempt to anticipate its conclusions. However, so far the preponderance of evidence has suggested that a leak preceded the fire and the explosions, which is bolstered by additional evidence that trouble with the tank material, due to the extreme low temperature of the liquefied gas, was encountered at the very start, requiring partial rebuilding of one tank. This indicates a material problem not yet fully understood, which it is hardly likely that the report will solve.

It is to be hoped therefore that final conclusions will not be reached too quickly, before all the facts are known. Otherwise a useful engineering advance may be condemned without adequate trial.

ATTRACTED BY PROGRESS

ONE OF the outstanding points in the recent report of the postwar planning committee of the American Gas Association was contained in the following paragraph:

> It is obvious that financial interests are attracted by the securities of those industries which show a progressive spirit and which continually safeguard their future through substantial expenditures for research and aggressive promotional effort. It is essential, therefore, that the gas industry in its own self-interest demonstrate its faith in the future of its business by appropriating adequate funds for research and promotional development.

Chemical engineers in other industries can properly use a similar argument. Sometimes it is necessary to do so in order to stimulate adequate attention and prompt action by the business executives who are not as close to the technical questions of research and development in relation to sound industrial expansion.

This argument has been very effectively used by AGA. It has stimulated a large new program to support research and promotion. These activities have been supported in recent years by about $400,000 per year. The new plan calls for $1,400,000. Even that larger sum is a very small percentage of the gross income of the gas utilities of the country.

Let's hope that the money will be wisely and effectively spent, in which case the results will do far more than enhance the value of the industry's securities.

MIDGLEY'S MONUMENT

HISTORY will eventually record in true perspective the enormous value of the scientific contributions Thomas Midgley, Jr., made to the world we live in. It remains for others to appraise the enduring influence of his inventions and discoveries on the automotive and aircraft industries. But those of us who have been privileged to work with and under him in the chemical profession realize how much we owe to his brilliant leadership. An active, eager worker in many engineering organizations and technical societies, the American Chemical Society was always closest to his heart. To him more than any other should go the credit for the changes in policy and purpose that have made that society so much more responsive to the welfare of its members. Cheerful and resourceful in the face of great discouragement, firm and unyielding in his honest convictions, yet patient and tolerant with us all, Tom Midgley gave his life for the people and institutions he believed in and loved. What could be more fitting as a monument than to name the society's new research foundation after the man who has given so much to the advance of the chemical profession?

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 WAR BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award a $50 Series E War Bond each month to the author of the best short article received during the *preceding* month and accepted for publication in the "*Chem. & Met.* Plant Notebook." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department.

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

OCTOBER WINNER!

A $50 Series E War Bond will be issued in the name of

W. F. CALDWELL

Development Engineering Div.
American Cyanamid Co.
Stamford, Conn.

For an article dealing with an improved design of sight glass eliminating glass breakage, which has been adjudged the winner of our October contest.

This article will appear in our December issue. Watch for it!

September Contest Prize Winner

SUBSTITUTING A TEMPERATURE RECORDER FOR A FLOW RECORDER FOR STEAM

ALFRED H. McKINNEY
Chemical Department
Philadelphia Quartz Co.
Philadelphia, Pa.

In some semi-plant experimental work it was desired to transfer a flow controller, used only as a flow recorder, to a more useful service controlling water flow in another line. The steam flow was separately controlled by a temperature controller. However, it was desirable to continue to have some sort of record of steam used.

Before removing the flow controller, thermometer wells were installed in the pipe approximately 3 in. on either side of the orifice and an attempt made to use the temperature difference between the two wells, instead of the pressure difference, to indicate the flow. The temperature difference was measured by a ten-junction thermopile constructed of 40-ga., enameled copper and Constantan wires and connected to Point (2) of a multi-point recording potentiometer. Point (1) read the room temperature. The potentiometer recorded 0-200 deg. C. on a 10-in. strip-chart against copper-Constantan couples. The temperature difference between Points (1) and (2) was used as the measure of the amount of steam flowing.

To calibrate the temperature record, the flow controller was set to various arbitrary flow rates, the steam was condensed and weighed, and compared to the temperature record as shown in the following table. The steam, at an unknown and perhaps variable quality, had a gage pressure varying from 105 to 120 lb. per square inch. The full-scale pressure drop across the orifice was 100 in. of water.

Flow Meter Reading, Lb. per Hr.	Steam Condensed, Lb. per Hr.	Temperature Difference, Deg. C.
0	0	−12
8.75	20.5	−4.9
17.5	35.2	+0.2
52.2	51.2	+0.4
70.2	66.7	+8.2
86.0	73.5	+12.8
off scale	145	+39.0

A smooth curve was drawn through the data plotted from Columns (2) and (3) which fitted the points to an average error of ±5 lb. steam per hour. A table of steam flow rates was then read off the curve which gave results which were valuable until a new flow recorder could be obtained.

It is very likely the sources of error could have been eliminated and much greater accuracy obtained, at the expense of time not here justified. One interesting feature is that the flow-temperature difference curve is only slightly curved, compared to the square-root scale usually obtained.

The potentiometer was quite sluggish in moving from Point (1) to Point (2), due to the resistance of the small wires used. However, it did get to its true reading before printing, since its travel was never over 25 percent of full scale from Point (1) to Point (2). This was checked by connecting Points (3), (4), and (5) in parallel with Point (2).

TANK GAGE FOR LIQUIDS OF VARYING DENSITY

J. M. ROEBUCK
Richmond, Calif.

Stick gaging is generally used to measure the contents of a tank, but when the liquid varies in density because of foam formation, suspended matter, or incomplete mixing, the weight of the contents has to be determined by other means.

If the tank is of constant horizontal cross section throughout its height, the weight of the contents can be determined by measuring the pressure at the tank bottom and multiplying it by the tank area. A simple and accurate means of measuring the pressure is with a column of liquid of known density. The height of the column is a direct measure of the weight of the tank contents and a chart relating the height to the weight can be prepared. If extreme accuracy is desired, a temperature correction chart for the gaging liquid used can be constructed.

If there is a gaging liquid available that does not contaminate the tank contents, small amounts of it can be added to the gage regularly to assure the purity of the gaging column. Otherwise a bladder can be used to separate the liquids.

A simply arrangement which accurately gaged a foamy liquid, consisted of two boiler glass tubes fused together and connected to the bottom of the tank with a boiler glass valve. Regular addition of small amounts of the gaging liquid was facilitated by installing a can with a petcock situated to drain the liquid into the gage. Frequent flushing was avoided by connecting a length of small diameter pipe to the gage valve and extending it across the tank. The glass tube was mounted on a wooden scale and protected with a metal guard. Plastic tubing might be used satisfactorily in some cases.

REPORT ON.....

PAINTS and VARNISHES

Recent Advances with Postwar Promise

The paint and varnish field, formerly one of the less developed members of the chemical process family of industries, has spurted forward by leaps and bounds within recent years. Primarily an art of formulation a decade or so ago, it can now be counted among the leaders in process progressiveness even though some vestiges of the long "rule-of-thumb" age still lurk in the darker corners of the industry. Technical men in the field, stimulated by raw material shortages and war demands, have made processing changes and introduced new lines of products that will carry over well into the postwar years. With little or no reconversion problem and with a tremendous new construction and deferred maintenance market just around the armistice table, the paint and varnish industry looks forward to the future with confidence and well-laid plans. From the long-range viewpoint, a more intensive application of the principles of chemical engineering together with the prolific data of chemistry promises to guide the field to new heights of industrial achievement and usefulness.

ONE OF THE OLDEST and until recently one of the most antiquated of the chemical process industries, the paint and varnish field has now been infected with renewed vigor and initiative, new courage to break with tradition. The forces that are modernizing and streamlining the industry have not spent themselves, but rather are gaining momentum. There is no going back now, for once having become enmeshed in the cycle of progress, all elements of the industry must keep up with events or quickly become bypassed and superceded.

Chemical engineers in general have not been too alert to the vast potentialities of the paint and varnish field. Here is a large industry, willing to change, generally in need of better equipment and engineering practices, an industry that could pay good dividends for high-class engineering ingenuity and efficiency.

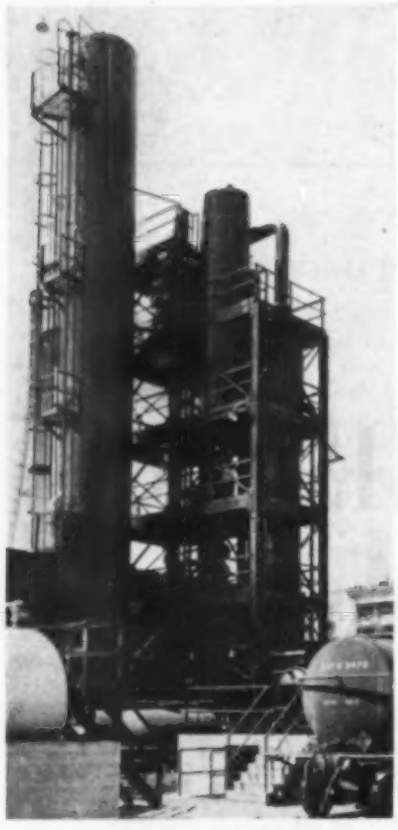
More important, perhaps, the chemical engineer must keep a keener weather eye on this rejuvenated field since (1) he is the chief supplier of raw materials, will become increasingly important in this role; (2) the problems of the industry are chiefly those of chemical processing and materials handling, special domains of the chemical engineer; (3) the engineer is one of the big users of the industry's finished products, chiefly protective coatings of all types.

ART OF FORMULATION

Historical phases in the development of the paint and varnish industry can be divided into three distinct categories: (1) As an art of formulation, a rule-of-thumb heritage; (2) as a chemical process industry with emphasis on chemical raw materials as a means of controlling characteristics of the finished products; (3) as a chemical engineering industry with emphasis on processing control and engineering aspects of equipment and manufacturing operations.

For thousands of years, until after World War I, the preparation of protective and decorative coatings was almost entirely an art; only a gifted man could produce paints and varnishes. These "artists" and their apprentices did not have to worry about alkali and acid resistance, infra-red rays or chalking; their lot was an easy one.

Then came an awakening, stimulated largely by the availability of new and improved raw materials and by the insistent demands from industry for better protective coatings. As a result, the past 20 years have witnessed the renaissance of this industry into a well-organized, competitive chemical business with technologists vying



This modern unit of the Pittsburgh Plate Glass Co. fractionates vegetable oils for use in paints

with each other to produce better finishes at less cost. Accent has been mostly on raw materials, and this era saw emphasis shift from the use of crude raw materials to use of fractionated or purified materials and, very recently, to the use of synthetic materials.

Still the industry was largely chemical; engineering concepts and practices had not been adopted to any appreciable extent. By 1939, at the outbreak of the war, some of the more progressive elements in the field were beginning to recognize the need for more modern engineering of equipment, materials handling and production methods. This trend has continued but has been seriously hampered by war scarcities and difficulties; after peace it will be greatly accelerated. Actually, at this time the industry as a whole is in a transition stage between a chemical processing industry and a chemical engineering industry.

Before reviewing some of the recent achievements of the industry, it will be well to remember that the chief efforts of all technical men in the field are focused on improving the quality of a product for a specified application and on lowering the final or applied cost of the finish to the customer. These objectives can be attained by various means through (1) cheaper or improved raw materials; (2) streamlined handling and processing methods; (3) larger production and handling units; (4) new or improved formulations; (5) more efficient distribution methods; (6) better or cheaper means of application. In the final analysis, it makes little difference whether an improvement in the quality or a lowering in the cost of the final film is brought about by means of a quicker drying oil, a more efficient cooking kettle, a more exact formulation, some new container design, or a better paint brush or spray gun. Notable improvements have recently been made in all these aspects.

NATURE'S GIFTS

Until about 1930, natural products dominated the drying oil and resin fields for the manufacture of finishes. But nature does not always produce duplicates and her raw materials are often far from ideal. The demands of modern industry, especially the automobile and refrigerator industries, brought about better finishes within a narrow range of limits. Synthetics, principally as alkyd resins, were developed to meet these demands. By 1928, enamels based on these resins had appeared on the market; by 1936 they had completely replaced lacquers in the refrigerator field and were rapidly gaining ground in competition with porcelain finishes. Urea-formaldehyde resins first appeared on the market in commercial finishes in 1937. Since about that date the synthetic resins have had a field day in the finishes industry.

More significantly, a change of attitude in respect to natural drying oils began to crystallize during the thirties—no longer did men in the industry look upon natural drying oils as God's gift to the painter, not to be tampered with. Efforts were then begun to improve these oils by chemical treatments and to develop other natural oils of superior properties. Oiticica oil was introduced in the United States as a competitor to tung oil in 1934. Improved varieties of flax and soybean were developed.

In the pigments field, this decade of the thirties saw the ascendency of titanium dioxide and its modifications as white pigments, development of lead titanate and the phthalocyanines. The titanium pigments have chemical inertness and do not form soaps with fatty acids, but their outstanding characteristic is their exceptionally high hiding power. Within the past ten years lithopone has been replacing white lead (which still represents about 8 percent of the gallonage of all paints applied) while in more recent years titanium has gained at the expense of both. Lead titanate, developed about ten years ago, has found use primarily because it serves to protect paint films from the decomposing action of the sun's rays and to render them more chalk resistant.

Phthalocyanine blue pigment, appearing on the market during 1935, has been hailed as one of the greatest single advances in pigment technology within this century. This substance is actually copper phthalocyanine. In tinctorial power, resistance to light, acids and alkalis, heat and weathering, it is the foremost blue pigment available. In some shades it has approximately twice the strength of iron blue and is 20-30 times as strong tinctorially as ultramarine. Phthalocyanine green, a poly-chlorinated copper phthalocyanine with 14-16 of its 16 hydrogen atoms substituted by chlorine, has also become of industrial importance. Actually, these pigments were just beginning to be used on a large scale commercially when the war started; their postwar future is already assured.

One of the outstanding prewar developments in the applications field was the development, chiefly by Devoe & Raynolds, Inc., of the two-coat system in place of the three-coat system for house paint. Evolution of this scheme was the outcome of strictly scientific detective work. Already there is developing a school of thought championing a one-coat system in spite of the formidable difficulties that are obvious.

WARTIME ADVANCES

Important were these 1930-1939 advances, but more important are those that have occurred or largely matured since the outbreak of the war. Chief among such advances have been: (1) Development of dehydrated castor oil as a substitute for imported tung oil; (2) industrialization of methods for producing conjugated fatty acids by catalytic isomerization; (3) intensified use of alkyd and modified alkyd resins; (4) development of polyhydric alcohols for use in place of glycerine in alkyd-type resins; (5) development of soybean oil base alkyds for non-yellowing interior paints; (6) marketing of improved types of titanium base pigments; (7) development of high-polymer synthetic resins in protective coatings; (8) development work on synthetic bristles for paint brushes; (9) improvements in water-thinned paints, especially those of the resin emulsion type; (10) improvements in design of varnish kettles and other equipment; (11) development of a vast number of finishes for specialized uses, particularly for military purposes and as industrial protective coatings; (12) new and improved methods of application or finishing, especially in industrial fields; (13) efforts to develop natural drying oils that can be produced in this hemisphere; (14) industrialization of processes for fractionation of natural oils and fatty acids.

Dehydrated castor oil was developed from the necessity of finding a suitable substitute for China wood oil, cut off by the Japanese. This development was pioneered and industrialized principally by Spencer Kellogg & Sons, Baker Castor Co., Woburn Degreasing Co., Sherwin-Williams Co., and Devoe & Raynolds Co.

In its original state, Brazilian castor oil is non-drying. However, by a process of dehydrating that results in a conjugated double bond, this oil acquires properties very similar to those of tung oil. In one process, dehydration is believed to be performed with a small amount of sulphuric acid as catalyst at a temperature near 500 deg. C. Treatment is continued until the iodine number of the hydroxy group is reduced from 130 to as low as possible. Spencer Kellogg & Sons, as an illustration, now has a number of large kettles of Monel or Inconel which operate under high vacuum and at high temperature and which can handle up to 40 barrels at one time. Sensitive catalysts have greatly reduced the time of operation and improved the quality of the product.

Demand for dehydrated castor oil in the paint and varnish field is increasing and will undoubtedly survive the return of tung oil since it is easier to handle in the kettle, being non-yellowing and free of odor. Before the shortage of oil, production of dehydrated castor oil in this country was reported to be in the neighborhood of 100,000 bbl. annually.

Related to the process of producing conjugated castor oil is the catalytic isomerization of soybean, linseed, cottonseed and other oils for alkyds or straight varnishes. These processes result in a drying oil by shifting of isolated double bonds to the conjugated position. Such conjugated oils help to fill the need for tung oil; in general they are probably about as good for the purpose as dehydrated castor oil.

Conjugation is usually brought about after the glycerol has been removed from the oil molecule. The conjugated fatty acid can then be processed and esterified with different types of polyhydric alcohols. Isomerized linseed oil seems to be a nearer approach to tung oil than isomerized soybean oil. It is evidently a satisfactory substitute for tung oil in the manufacture of insulating varnishes, wrinkle finishes and baked finishes of all types. Use of conjugated oils and fatty acids will continue to increase and considerable advances in this field are to be expected.

In fact, some persons in this field expect that with an almost certain shortage of tung oil after the war because of devastation of tung trees by the Japs, the chief drying oils for high-quality paint products are likely to be polymerized linseed oil, dehydrated castor oil and Brazilian oiticica oil in moderate amounts.

THE ALKYD REVOLUTION

Although the alkyd resins were developed a number of years ago, these materials were actually just getting into their stride in the coatings industry when the war broke out. Opinion is unanimous that the alkyds will continue to thrive and that in the postwar period they will almost certainly replace the phenolic resins in the field. The true alkyds are glycerol phthalates modified with fatty acids; the combination usually is phthalic anhydride, fatty acids and glycerol.

Films of alkyds are very resistant to ultra-violet light, salt water in marine uses, and temperature changes, besides being very tough. Alkyd resin paints and finishes are now going almost exclusively to war uses, but they are expected to play an important part in the postwar building construction field. They are much more durable than some of the prewar paints and are well suited for application on metals.

Soybean-base alkyds have recently attracted favorable attention for use in non-yellowing interior paints. These resins are simply alkyds in which fatty acids are replaced by soybean oil. Pentaerythritol and other polyhydric alcohols can be used in place of phthalic anhydride.

Closely related to the true alkyds are the modified alkyd resins, all of which will become of increasing importance in the field of industrial finishes to help satisfy the insistent demand for materials that can be air dried or baked very quickly. Organic acids such as maleic anhydride and fumaric acid will be used on a larger scale for modification of alkyd resins.

High polymer resins based on the vinyls, methacrylates, allyls, styryls, terpenes, melamines, synthetic rubbers and other such compounds which have largely been unavailable during the war, will be used in the postwar years for specialized industrial applications.

Certain synthetic rubber compositions are definitely promising for postwar use in the synthetic coatings industry. Polybutanes, polybutadienes, butyls, acrylonitriles and allyls show promise. Polyhydric alcohols such as pentaerythritol or polypentaerythritols, mannitol, sorbitol and trimethylolpropane esterified with fatty acids are rapidly finding favor, primarily because of their speed of drying and special characteristics. Some of these may eventually replace a considerable volume of glycerol. Azelaic and pelargonic acids, recently announced as available by Emery Industries, Inc., may serve as raw materials for some interesting products.

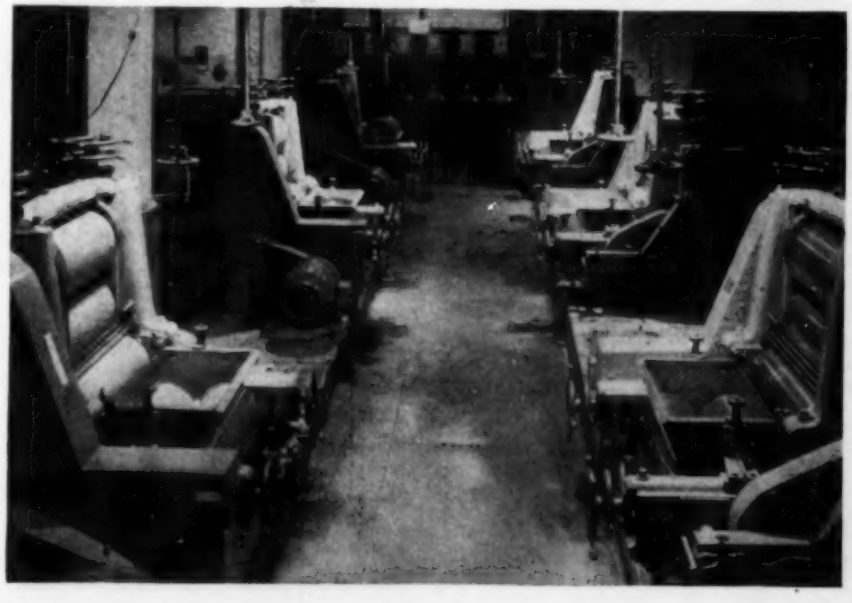
Latest development is allyl starch, made by treating starch with allyl chloride, a new type of resinous coating material that looks like varnish and is reported to withstand temperatures up to 400 deg. F. and the action of most chemicals and solvents. Developed by the Eastern Regional Research Laboratory, this material is attracting considerabl attention in varnish and lacquer circles.

In short, very recent developments in the synthetic resin and high polymer fields are bound to have a tremendous, perhaps a deciding, influence on the industrial finishes industry. Once thoroughly involved with these synthetic materials, the coatings industry will find itself pulled along in the wake of the dizzy progress of the synthetic resins field.

GETTING OUT THE LARD

Notable work has been done in recent years on the segregation of natural oils. By using the principle of solvent fractionation or liquid-liquid extraction the highly drying fractions can be removed from the non-drying fractions of an oil. The process can be applied either to the original oil where solvents are used which have more affinity for unsaturated glycerides or to polymerized oils where solvents are used which dissolve the non-drying unpolymerized fractions. In linseed oil the non-drying, lard-like constituents which are

Modern paint factories now use 5-roll mills in place of buhrstone mills



removed amount to as much as 10 percent of the oil. They are principally glycerides of oleic and stearic acids.

The Pittsburgh Plate Glass Co. process for molecular selection of glyceride oils, for instance, separates linseed oil into an extract fraction having the properties of perilla oil and closely approaching tung oil in its characteristics in varnish manufacture. The raffinate fraction obtained is similar to soybean oil and is useful in foods or in resin manufacture. Soybean oil treated in the same manner produces a low-cost substitute for linseed oil and a food fraction comparable to cottonseed oil. A high iodine fish oil fraction can be produced which is a substitute for tung oil.

It might here be pointed out that those elements of the industry concerned primarily with treatment of drying oils, such as dehydration of castor oil, catalytic isomerization of natural oils, production and modification of alkyd and other synthetic resins, and the fractionation of fatty acids, are based on sound chemical engineering principles and are modern and efficient in design. Obsolete methods in the industry are fairly well concentrated in the actual paint and varnish making operations.

One of the most promising recent developments in the natural drying oils is the discovery of *Garcia nutans*, a tree that grows in Mexico and Central America. Oil from the seed of this plant has, in experimental work, shown promise of being something like a super tung oil and apparently has a higher percentage of the same conjugated acids as tung oil. The oil is highly unsaturated and seems to consist principally of eleostearic glycerides; it contains no licanic or linolenic acids. However, a recent survey has shown that the supply of Garcia *nutans* trees in Mexico is very limited, and that a planned planting program must be undertaken before any appreciable quantity of the oil can be obtained.

Other new developments in natural drying oils include sunflower seed oil, which seems to be better than soybean oil as a tung oil substitute but which is lacking in steady supply, and milkweed seed oil. Work on the latter source was commissioned by OPRD and WPB. Oil occurs in the milkweed seed as about 23 percent of the total weight of the seed. In character, the oil resembles soybean oil except that it is somewhat superior in non-yellowing qualities. Obtaining a steady supply of seed seems to be the major difficulty.

FROM ANATASE TO RUTILE

Prior to 1941, all titanium dioxide pigment had been of the anatase form of crystallization. In that year a rutile crystal form of titanium dioxide was put on the market. This involved a fundamental change in the crystal structure of the dioxide which increased its specific gravity and index of refraction to give a pigment with a 20–40 percent greater hiding power than any titanium dioxide previously available.

Non-chalking titanium pigment is prepared by recrystallization of fine anatase titanium dioxide to coarse rutile titanium dioxide with zinc oxide as a catalyst. The zinc oxide is probably coated on the pigment in the form of zinc titanate. Usually about 1 percent of alumina, silica or zinc oxide is coated on the titanium dioxide. Generally a combination of any two of these oxides is used.

Introduced in 1942, this new treated rutile has chalk resistance comparable with the non-chalking, zinc-treated titanium pigment previously used but in addition has the hiding power, color and tintability of high-grade rutile pigment. The urgent need for a pigment of these properties for use as a camouflage or protective coating on ships, planes and tanks has led to its widespread use by the United States government.

Rutile titanium dioxide is also now available as a titanium calcium pigment in a variety of grades. Development and commercialization of these new titanium pigments has been accomplished by the Pigments Division of E. I. du Pont de Nemours & Co. and by the Titanium Pigment Corp.

RESIN EMULSION PAINTS

Although postwar demands for water-thinned paints of casein and other protein bases will be considerable, the alkyd and other resin oil-in-water emulsion paints will probably be in greater demand. These, having greater resistance to washing and scrubbing, have already come into wide popularity because of their lack of odor, high hiding capacity, and brushability. Hiding power has been increased by using titanium dioxide, which normally does not disperse in water, coated with a soluble phosphate by a special finishing process. Principal remaining objection to the resin emulsion types is that their cost has been increased over that of a straight casein paint. Lowering costs to a point where they closely approximate those of straight casein would probably cause considerable replacement of the latter.

To prevent changes in consistency during storage, present practice generally consists of making a stabilized casein solution by denaturing the casein at 160 deg. F. or higher in the presence of a solvent. A plasticizer such as glycerol is usually present. Reactivity can be largely prevented by avoiding soluble calcium compounds or reactive zinc compounds, such as the oxide. The drying oil can be a straight oil, an oil-modified resin, or a varnish.

Oil-in-water emulsion paints are available in two general types: interior and exterior. The interior types have already come into wide use and will in all probability increase in popularity. For exterior use emulsion paints are used on concrete and masonry surfaces; for many applications they compare well with good grades of alkali-resistant oil paints. Further improvements are certain and their future prospects are bright.

If the entire paint industry is considered as a $600–800 million industry, it is likely that the water paint business (principally emulsion paints) still does not amount to more than about 2 percent of the total. Some authorities in the field believe this proportion will quickly rise to 10–15 percent. Public hospitals, buildings and other installations where continuous occupancy makes odor-free and fast-drying paints imperative will be among the larger postwar users of oil-in-water emulsion paints.

WAR PAINTS

Paints developed or modified primarily for specific war purposes will be dealt with chiefly insofar as their postwar prospects are concerned. Such war products can be classified into four broad groups: (1) Products developed to withstand extreme or unusual weather or climatic conditions; (2) camouflage materials; (3) luminous and fluorescent compositions; (4) maritime paints.

The necessity of fighting this war in all types of heathenish climates has forced our paint and varnish industry to develop protective coatings always a bit tougher than the conditions on the ice packs, scorching deserts or mildewed jungles where they are used. Such products have been developed principally by selection and modification of well-known materials rather than by discovery of entirely new types of products.

Some of these war specialty materials will find postwar use; the aviation industry, for instance, will need films that can withstand the low temperatures of the stratosphere as well as desert heats and salt sprays. Dibutyl sebacate or mixtures of dibutyl or dibenzyl sebacate with dibenzyl phthalate may prove useful in imparting low-temperature flexibility to otherwise brittle film compositions. Postwar trade with South America and certain Pacific areas may require special protective coatings such as, for example, the lusterless synthetic enamel or lacquer rust inhibiting coatings for tin containers now in use.

Promising work has recently been made on mildewcides and mildew-resistant paints. Zinc oxide is widely used in practically all outside house paints primarily because of its fungistatic action. After the war some of the special mildewcides developed for military uses will most likely be incorporated into interior as well as exte-

rior house paints, cellar finishes and paints for industrial establishments in which a highly humidified condition must be maintained.

Great progress has naturally been made in the use of camouflage paints and coating materials. Flatness, of course, is one of the most important factors in all such materials. Water-thinned emulsion paints are widely used for field applications, as well as for industrial sites and airport runways and hangars. Some authorities hold that this wartime role of camouflage paints may soon be reversed so as to allow positive identification and thus make the ground a road map for fliers.

War necessity has created a sizable market for luminous and fluorescent compositions. Very few of the luminescent pigments can be classed as new, but recent applications are new in both scope and magnitude. Increased production volume and efficiency have lowered costs of luminous paints from the prewar level of $10-25 per lb. to the present range of $1-2 per lb. Thus a wide postwar market can be expected. Safety applications can become widespread in both home and factory use, reducing household as well as industrial accidents. Other potential and probable uses include illumination devices in case of power failure, warning and directional signs, special advertising, on household door knobs and light switches, corridor and stairway guide lines, street signs, and novelty applications.

Most durable compositions employing calcium and strontium sulphides, the phosphorescent pigments with most widespread application, have used a laminated resin board in which the luminescent pigment coating is heat-sealed between two layers of thermoplastic resin.

During the past few years tremendous progress has been made by the industry in improving the quality and durability of anti-fouling and other marine paint compositions. The need to repaint possibly 50 million deadweight tons of merchant shipping and to provide maintenance paint for the world's largest navy will keep the marine paint industry at a high level for years. It is probable that the use of some of the newer resin materials in anti-fouling finishes will greatly improve their durability and effectiveness.

NEW PRODUCT TRENDS

Idea men in the paint and varnish field have not been idle during the war. They are now about ready to market some of the new products developed during the war as well as those whose development or introduction to the trade was interrupted by the outbreak of hostilities. Improved non-yellowing interior house paints, such as those based on certain soybean alkyds, will be generally available. The same will probably be true of interior paints more resistant to hard scrubbing with water and alkali and of exterior paints more resistant to ultra-violet damage. Lead titanate, alkyd resins and phthalocyanine pigments will be more widely used in ultra-violet resistant paints. Considerable promising study has been devoted to developing all-purpose interior flat paints. It is reported that a paint has already been developed such that a single coat is equally effective on plaster, woodwork, composition board, metal, concrete, or almost any other type of building material.

Considerable attention has been given in recent years to the development of germicidal paints, but without too much success. Use of chlorphenols and oxyquinoline sulphate seems to offer most promise. Development of DDT and attention to its remarkable insecticidal efficiency, partly due to its stability, low volatility and insolubility in water, has led some persons to hope that this material may be successfully incorporated into certain types of finishes for house and barn interiors, hospitals, beds, window screens and pantries for the control of household insect pests.

Soon after the war there will once again be created a large outlet for improved zone-marking or traffic paints for highways, parking spaces and the like. These are rapid-drying varnishes with vehicles based on either spirit or oleoresinous varnishes. Total consumption of traffic paints has developed into a surprisingly large volume.

It is held likely that varnish formulas may soon go up to 80 percent binding material as compared to about 50 percent at present. Large quantities of volatile solvents could thus be saved. At the same time such varnishes would have quick drying and very good working characteristics.

Considerable progress has also been made in the field of specialty industrial finishes. These, largely based on new resin and high-polymer compositions, will become available as soon as the war situation allows an easing up on military demands for both raw materials and finished products. It is certain that after the war chemical and maintenance engineers can look forward to many interesting new and improved products from which to select a composition most suited for any particular use.

METHODS OF APPLICATION

Considerable development work has been done in recent years on improving methods of applying protective and decorative films. Such work is more than justified, for the cost of applying a paint film is often 75-80 percent of the total cost for a house paint and 50 percent or more for industrial coatings. Thus, a small improvement to lower application costs or to shorten the time requirements may have more to do with making or breaking a line of products for a specified use than radical improvements in manufacturing methods. The automobile would never have emerged from the cocoon stage if each unit had to be painted by hand brush and allowed to dry for days.

It is predicted that radical improvements in methods of application, particularly for industrial purposes, will be made within the next decade. Some of these improvements are already beginning to take shape. Many more will be stimulated for various reasons, chiefly (1) modern industry's

Mixing problems have always been troublesome for the paint maker. This is the mixing floor of one of the more modern factories

constant demands for better and quicker results, and (2) indications that some union leaders may try to keep postwar labor wages at unreasonable wartime ceilings, if necessary by inspiring a series of strike tantrums.

More extensive use of hot dipping methods may be developed. However, the only present application of hot dipping in the paint field is for applying ethyl cellulose strippable coatings for protection of machinery and metal parts during long shipments. Widespread use of other hot-dip materials would call for closer attention to stability of the compositions in the liquid phase. The present ethyl cellulose dip is now being made by Dow Chemical Co. and Hercules Powder Co.

An entirely new method, largely in the experimental stages, for finishing both wood and metal is the use of a low-melting synthetic resinoid without a solvent to be applied by spraying from an electrically heated atomizer. Temperature would have to be uniform and perhaps considerably over 200 deg. F. In certain experimental tests the sprayed molten material was hard and dry in less than 15 minutes. Advantages would be a substantial saving of solvent, a thicker film on the object, and quicker drying.

Another innovation in spraying is the use of a high-voltage electrostatic field with the article attached to the positive pole. This method aids in removing tears and beads and in producing an even coating, since the spray travels around the corners, edges and other areas not directly covered by the gun. Electrostatic painting may spread to the spraying of such large objects as ships, freight cars or airplanes.

Infra-red lamps have been widely adopted as a source of heat for baking enamels. These save time and space and will continue to grow in popularity and usefulness in the finishing field. Low-pressure discardable paint cans using a gas under pressure as the propellant have been mentioned as possibilities, but as yet these have not proved practicable.

At least three firms have developed synthetic paint brush bristles within recent years and these will be generally available as soon as raw materials become more abundant. The firms are E. I. du Pont de Nemours & Co., with its nylon brush, Devoe & Raynolds Co., and Pittsburgh Plate Glass Co. It is generally agreed that after the war these brushes can be made cheaper and better in quality than those made from Chinese hog bristles. One synthetic bristle now can be made for about 10 percent of the cost of imported hog bristle. Extruded cellulosic filaments will probably be lowest in cost.

NEED FOR ENGINEERING

Until only just before this war, equipment and engineering advances in the paint and varnish factory had more or less stood still for fifty years while research and advanced methods in raw materials manufacture had made steady progress.

In varnish making, for instance, expensive oils and resins were selected, carefully tested and then put into small open pots of 100-400 gal. capacity over a roaring, direct fire. Copious fumes would roll off and the varnish would be at least partially decomposed before leaving the kettle.

A number of progressive firms, among the first which was Devoe & Raynolds Co., have now installed stainless steel jacketed kettles heated by Dowtherm or other indirect means and equipped with adjustable stirrers. In these, a charge can be heated to its maximum temperature within an hour; automatic control devices keep the temperature constant. Batches of about 1,000 gal. can now be run with no pulling of the kettle and no cooling before thinning. The new kettles pay for themselves by savings in solvent and fuel alone within five years. Perhaps more important, the finished varnish is superior in quality since it has not been injured by overheating.

Not very many years ago a well-equipped paint factory had a number of buhrstone mills for grinding with perhaps a single roller mill for grinding flat paints. The buhrstone mill is gradually being displaced by ball and pebble mills and especially by high-speed three- or five-roll mills. The tendency in recent years has been to increase the speed of the rollers.

The industry has not yet adopted continuous processing, although such methods for the manufacture of varnish may be in use fairly soon. One of the principal reasons, of course, why better equipment and processes have not been developed sooner is the large number of different materials and products handled. It has not been exceptional in normal times for a large paint house to use upward of 1,000 raw materials and to supply perhaps 20,000 different items of all colors and package sizes. Packaging requirements alone normally range from half-pint cans to tank cars. Such diversity of materials and handling problems is not conducive to large-scale operations and the accompanying opportunities for engineering efficiency.

POSTWAR PROSPECTS

Greatest outlets for paint products in the early postwar years will be: (1) Repairs and maintenance, both industrial and residential; (2) new residential construction; (3) production of durable goods; (4) marine maintenance; (5) exports. Postwar prospects for each of these are more promising than was its prewar status.

It has been stated, for instance, that the deferred maintenance market for the coatings industry has now piled up to several billion dollars. Of this, some 10-20 percent may represent residential maintenance in need of immediate attention. It is anticipated that as soon as materials and labor become available 1,000,000 new homes will be built annually for some years.

Some of the railroads have indicated that they have widespread postwar maintenance and repair plans, including the scrapping of considerable present rolling stock. The needs for repainting perhaps 50 million deadweight tons of merchant shipping will be considerable.

Foreign trade in finished paints and varnishes has not been an important factor in the domestic industry since many paint factories have been built in foreign countries within the past 15 years. Exports normally amount to about $5-8 million a year, less than 2 percent of the total industry. This may increase appreciably for a few years, but long-term prospects for exports are not particularly promising.

Much thought has been given to the possibility that new materials, particularly plastics, may eliminate the need for paint finishes. The reverse will most likely be true. Colored plastics may eliminate paint to some extent, but unpainted polished plastics are usually easily dulled or scratched and hard to match.

Paint men remember that the light metals generally require some coating for either surface protection or decoration. The plywoods, expected to come into their own in a big way, will certainly be coated with some product of the paint industry.

One thing is certain: accent in the paint and varnish field is now on progress—on improving raw materials, modernizing operations, broadening the usefulness and range of specialty products, lowering application costs. This trend has been, to a very large extent, initiated and encouraged by the alert leadership of the technical associations in the field, the National Paint, Varnish and Lacquer Association; the Federation of Paint and Varnish Production Clubs; and the Paint, Varnish and Plastics Division of the American Chemical Society.

The paint and varnish industry has now largely passed through the transition stage from an art of formulation to a chemical process industry. The driving force within the field that brought about this change has by no means spent itself, and the drive is now turning in the direction of chemical engineering. From both the production and the application viewpoint, chemical engineers are finding that the paint and varnish field pays good dividends for those who follow it closely.

Reprints of this report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

SHAFT SEAL

ELIMINATION of stuffing box leakage on rotary-shaft machinery such as centrifugal pumps and rotary compressors, agitators and speed reducers, is claimed for the new mechanical seal announced by Crane Packing Co., 1881 Cuyler Ave., Chicago 13, Ill. As supplied, the unit is complete, ready to use. Referring to the accompanying illustration, it consists of three major parts, a flexible synthetic rubber bellows, the tail end of which grips and seals along the shaft; stationary floating seat, held in a synthetic rubber sealing ring; and a positively driven sealing washer, which turns with the shaft and is held against the stationary seat by spring pressure. The contacting faces of the washer and seat are lapped to form a leak-proof seal. The use of the flexible bellows, which offers no resistance to the spring, permits the sealing washer to move as required, providing automatic compensation for wear, shaft vibration and end play.

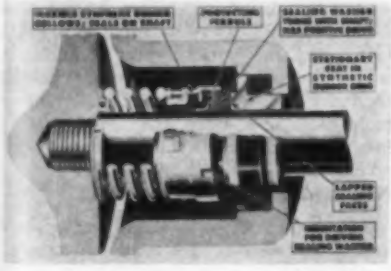
IMPROVED ELECTRICAL INSULATION

WHERE design limitations are based on insulation temperature, as much as 50 percent reduction in weight of electrical equipment is said to be possible by the use of the new silicone insulating varnishes which are now being developed commercially by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Such high-temperature insulations also make possible a substantial increase in the output of small motors using the same frame, where the operating temperature can thus be raised. They offer additional advantages of ability to operate with higher ambient temperatures and to give greatly increased life when operated under present temperature conditions.

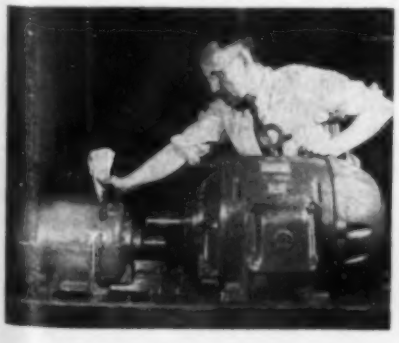
Recently developed silicone resins and varnishes have tremendously better thermal endurance than any of the known resins and varnishes. New high-temperature insulations have been developed utilizing these materials, and the electrical equipment using them has much greater thermal endurance, as high as 20 to 1 in laboratory tests. Physically, the new substances are quite similar to the conventional resins and varnishes, but they differ in that they do not readily decompose at temperatures of the order of 400 deg. F.

The materials have been used on actual equipment for over two years, confirming extended laboratory tests. As an example, a 3-hp. totally inclosed induction motor was redesigned for 10 hp. with no increase in weight or size. A 250-kva. generator, with this insulation, was operated in the laboratory for about 3,000 hr. at 480 deg. F., with no ill effects to the insulation. The new insulations are not expected to be a panacea for all insulating ills, but instead will be used in specific applications where their use is justified.

Cut-away view of mechanical shaft seal



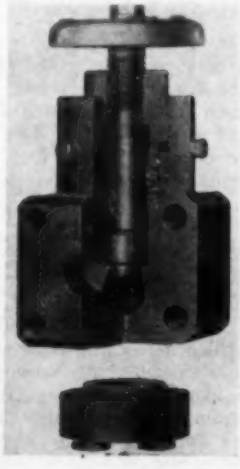
Both the smaller silicone-insulated motor and the conventionally insulated motor shown here developed 10 hp. at 1,750 r.p.m.



KARBATE VALVE

ANOTHER recent addition to the expanding line of Karbate process equipment produced by the National Carbon Co., Cleveland, Ohio, is a new corrosion resisting globe-type valve which now makes it possible to install complete liquid-handling and heat-transfer systems constructed entirely of Karbate. This impervious graphitic material is said to resist practically all corrosive chemicals and to be unaffected by extreme thermal shock. The new valves are produced in 1- and 2-in. sizes for operating pressures up to 50 lb. per sq. in. They are small, light in weight and designed with short face-to-face dimensions. The valves are equipped with adapter plugs for steam heating those liquids which tend to crystallize or solidify when handled through unheated lines. Utilization of such plugs for steam heating the valve assists in preventing clogging and thus avoids shut-downs for valve cleaning.

Cut-away Karbate globe type valve



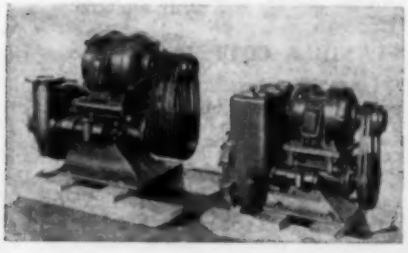
NOVEL PUMP DRIVE

AMSCO-NAGLE centrifugal pumps of the horizontal type, manufactured by the American Manganese Steel Division of American Brake Shoe Co., Chicago Heights, Ill., are now available with the motor mounted on top of the pump, driving through a V-belt drive, as shown in the accompanying illustration. The new arrangement requires less floor space, makes the motor more accessible, and protects it against possible flooding. It also permits speed changes to be made readily. The new drive is available for the manufacturers' Type A and Type T pumps, such as those shown in the accompanying illustration.

WATER SEPARATOR

DESIGNED originally for the separation of water from high octane gasoline, but also available for a variety of other industrial de-watering applications, such as in vegetable oil processing, is a new separator offered by Warner Lewis Co., 710 14th St. N.W., Washington 5, D. C. The new separator is claimed to deliver gasoline 99.999 percent water-free. Presumably, similar results can be obtained in the dewatering of other liquids where the water exists in emulsion rather than solution form. The separator consists of a horizontal cylindrical vessel containing at one end a mass of special separating medium consisting of a chemically treated excelsior-

New overhead pump drive



like material which is claimed to cause emulsions to break, allowing droplets of the dispersed phase to coalesce. The liquid to be dewatered enters at one end of the vessel, passes through the separating medium and then flows through a void section without baffles in which the coalesced droplets settle out. A water accumulator chamber beneath the main vessel at the discharge end contains an automatic water-discharge valve operated by the density difference between water and gasoline and also contains the probe of an electronic alarm system to shut down the pump should solid water start coming through the equipment. These separators, which are known under the trade name of Excel-So, are built in sizes of 25 to 1,000 g.p.m., for low pressure differentials. The separating medium is said to last indefinitely except where, through its filtering action, it may eventually become clogged with solids carried by the liquid being purified.

IMPROVED REDUCTION UNIT

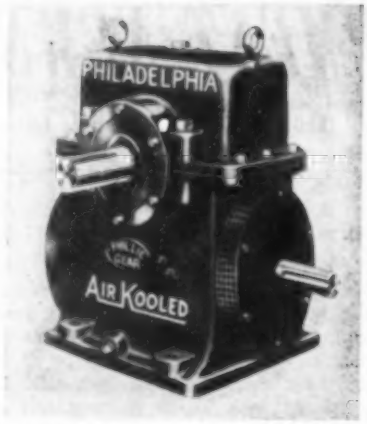
MATERIAL increase in horsepower rating compared with standard heavy-duty type units for worm speeds of 580 to 1,750 r.p.m., is accomplished by air cooling in the new "AirKooled" reducer announced by Philadelphia Gear Works, Erie Ave. & G St., Philadelphia, Pa. In this speed range the ratings are said to be approximately doubled at all ratios. At higher worm speeds, horsepower ratings of standard worm gear units are limited due to the rise in temperature of the oil bath. By the incorporation of a cooling fan on the worm shaft and suitable air passages, the new unit dissipates the heat from the inner ribbed housing to the air. At 1,750 r.p.m., where the rating advantage is greatest, the new unit is about two sizes smaller than a standard unit of the same capacity, resulting in great saving in space and approximately a 40 percent reduction in weight.

ALL PLASTIC GOGGLES

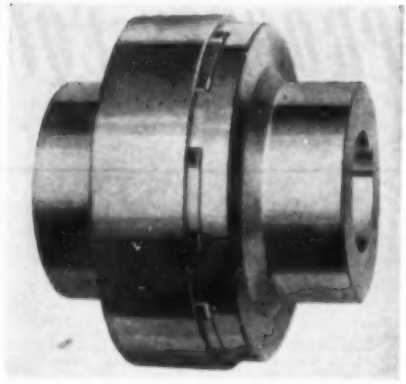
KNOWN AS Looks, a new line of all-plastic goggles has been introduced by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa. These goggles feature light weight, wide vision and comfort and employ individual eye cups molded to fit the facial contour. They are designed to provide a close yet comfortable seal around the eye orbit. Large "aviation-type" lenses afford a wide unobstructed angle of vision. The clear plastic frames are available in two styles, a general-purpose type providing direct ventilation through holes at the top and bottom of the eye cups; and a dust type with indirect ventilation through serrated lens seats. All lenses are of polished sheet acetate, clear or green in color, and are quickly and easily replaced.

FLEXIBLE COUPLING

GREATER SAFETY to personnel is an important feature claimed for the new L-R Type C shrouded flexible coupling recently announced by Lovejoy Flexible Coupling Co., 5009 West Lake St., Chicago 44, Ill. The new feature consists of an outside steel collar which holds the load cushions in place. An extension of this collar, which encircles the coupling, safeguards material and fingers from the heads of the bolts which secure the load cushion retainer. The bolt heads are concealed, yet easily and conveniently reached when necessary. The design is more compact, with a smoother external surface. These couplings are built for heavy duty service from 4.6 to 806 hp. at 100 r.p.m. Types are available for direct attachment to the flywheel, as well as drum types, and others for rapid disassembly without disturbing drive or driven equipment, etc. These couplings employ cushions of various materials adapted to the particular service for which the coupling is used. The cushions are always in sight. In operation half of the cushions are idlers (except on reversing load), so that a new set of cushions is always ready.



"AirKooled" worm gear reducer



Improved shrouded flexible coupling

Improved precision balance

CONVEYOR IDLER

TROUGHED carrying-run idlers, flat-roll carrying and return idlers, troughed self-lining idlers, and self-aligning return idlers are included in the new line of Type 100 anti-friction conveyor idlers recently announced by the Link-Belt Co., 307 North Michigan Ave., Chicago, Ill. Features of these new idlers include a positive grease seal to keep the grease in and the dirt out of the anti-friction bearing; troughing rolls accurately aligned in a sturdy stream-lined steel frame assembled in jigs to assure correct bracket spacing and roll interchangeability; roll shaft locked into the frame, yet quickly and easily removed; interlocking nuts and yokes to keep the roll supporting brackets from spreading; pipe extensions for safe center-roll lubrication from one end of the troughing idler unit; and all rolls in each troughing idler of the same length, and interchangeable. The new design is the culmination of a long series of designs employed by this company since 1896.

PRECISION BALANCE

SEVERAL IMPROVEMENTS have recently been incorporated in the line of precision balances manufactured by Roller-Smith Co., Bethlehem, Pa. These balances which are available in various ranges from 0-3 mg. to 0-2,000 mg., 0-3 grams to 0-50 grams and 0-10 grains to 0-1,000 grains, are intended for the rapid weighing of small mechanical parts, small quantities of chemicals or granular substances such as gunpowder charges, etc. Through the incorporation of a magnetic damper the balances are now brought quickly to rest without affecting accuracy, thus materially speeding up the weighing operation. Another improvement results from the use of an anti-parallax pointer and a hand-drawn scale in place of the formerly used vernier pointer and printed scale with mirror. Operation is simple. With the weighing beam loaded, the index pointer is rotated until the beam is lifted and the parallax pointer indicates zero. The position of the index pointer then indicates on the dial the weight of material. The reading is obtained directly in whatever calibration units are used.

NEW METALLIZING GUN

METCO TYPE 3E is the designation of a new metallizing gun for spraying such metals as zinc, tin, lead and copper, which has been developed especially for high-speed production spraying of low-melting-point metals by the Metallizing Engineering Co., 38-14 30th St., Long Island City 1, N. Y. Using ⅛-in. zinc, tin, lead, solder, babbitt, cadmium or fine-gage copper and copper alloys, the new gun is said to exhibit spraying speed far exceeding anything previously attained with these metals. Rates of deposition in pounds per hour include: zinc, 40; tin, 70; lead, 110; solder, 90; and babbitt, 75. Regardless of the type of wire employed, change gears are not required to achieve these high speeds. Any spraying speed within the prescribed ranges is automatically obtained and maintained by a controlled power unit

which is an integral part of the gun. Air pressure fluctuation is said not to affect its operating efficiency. Owners of this company's Type E or 2E guns may have their present equipment quickly converted to the new Type 3E. Uses suggested by the makers include the spraying of corrosion-resistant coatings on iron and steel structures and equipment and the production of chemically resistant linings for storage tanks and similar equipment, as well as the production of conductive and soldering surfaces on glass, plastics and carbon products.

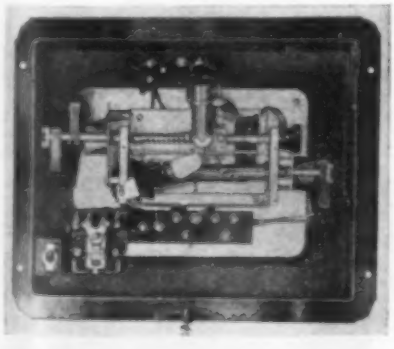
NEW INSTRUMENTS

THREE NEW instruments for industrial control, and refinements in a fourth, have been announced by Wheelco Instruments Co., Chicago 7, Ill. Two of these new instruments, designated as Inputrols, are designed to control the input of power, heat, or the flow of liquids or gases to any process equipment. The third, known as a Throttltrol, is designed to correct variations in the heat supply of furnaces and process equipment by positioning a valve in the fuel line. In addition, the company's Rheotrol, a manually operated controller for regulating the input to electrically operated heating equipment, has been refined and is now offered in a flush-mounted case.

The Inputrols are offered in automatic and manually set models, the basic elements- consisting of a mercury switch mounted on a carriage, a rotating horizontal cylindrical cam, driven by a small synchronous motor, and a spiral on which the mercury switch carriage is mounted. In the automatic model, which is used with a pyrometer, the spiral is turned automatically to position the mercury switch carriage at the proper point along the rotating cam. In the manual model the spiral is set by hand to the input point desired by the equipment operator. The scale is calibrated in terms of percent of maximum input. If the pointer is set at 60, for example, the mercury switch will be in the "on" position 60 percent of the time.

The Throttltrol is essentially a simplified valve-positioning device for use on high-and-low contact control instruments. It controls variations in heat requirements caused by changes in load, control settings, air and fuel pressure, heating values and combustion efficiency. At a given setting it will permit a fuel valve to open only the desired distance when the control instrument is in the "on" position. It thus makes for a more constant flow of fuel and minimizes the "overshooting" danger inherent in two-position controllers.

New Wheelco Inputrol



Heat lamp with Lo-Glo MM filament

IMPROVED HEATING LAMP

AS A RESULT of two years' research and experimentation, the Wabash Appliance Corp., Dept. 13, 345 Carroll St., Brooklyn 31, N. Y., has announced incorporation of a greatly improved tungsten filament into the Birdseye infra-red heat lamp of its manufacture. Known as the Lo-Glo MM filament, this new feature is of coil-coil construction, designed to burn at a lower color temperature, thus reducing spectral glare. In addition, the new filament is said to increase the radiant energy output as compared with other filaments of the same wattage. The shape of the new filament is said to eliminate cold spots and to produce a better focused and more effective pattern of radiation. The service life is claimed to be nearly double that of ordinary drying lamps.

PRESSURE REGULATOR

A NEW pressure regular, designated as the Nullmatic, has been developed by the Moore Products Co., H & Lycoming Sts., Philadelphia 24, Pa. This regulator has been designed to hold air pressures constant, regardless of changes in flow, as well as variations in supply pressure. It operates on the pneumatic "null" balance principle and, according to the manufacturer, might better be described as a pressure controller since the main air valve is operated by a detecting nozzle. The nozzle operates with a constant differential pressure to hold the manual loading spring at essentially the same position, regardless of variations in flow or in supply pressure.

The regulator incorporates an automatic bleed, to operate when a reduced regulated pressure is required. The automatic bleed also serves to permit reverse flow when the regulator is used as a limit control on industrial instrument applications. A separate safety release operates a few pounds above the regulated value.

All materials in contact with the air are corrosion resistant and the special neoprene diaphragm used is suitable for continued operation at temperatures up to 225 deg. F. Setting is accomplished through a manual adjusting knob and fine thread. Three standard ranges of 0-15, 0-30, 10-50 lb. per sq. in. are available, the instrument being suitable for supply pressures up to 150 lb. per sq. in. With a supply pressure of 100 lb. and a 25-lb. regulated pressure, the maximum capacity is about 10 standard cu. ft. per minute.

Null-balance pressure regulator

PLUG COCK GREASE

RETENTION of consistency, high resistance to corrosive chemicals, non-volatility, and thermal stability, are claimed for a new plug-cock grease recently announced by Dow-Corning Corp., Midland, Mich. The new grease is a silicone material having a vaseline-like consistency for use as a grease in lubricated plug cocks and other valves requiring lubrication. It has been found especially valuable, according to the manufacturer, in plug cocks which must operate at elevated temperatures or handle corrosive chemicals. The new product is unusual in that it remains a soft grease and will not harden or melt over the temperature range between minus 40 deg. F and plus 400 deg. F. The vapor pressure of this grease is stated to be negligible even at 400 deg. F. This property prevents contamination of the product by volatile material from the lubricant.

The new grease is inert, has no corrosive action on metals, and does not swell or deteriorate rubber, synthetic rubber or plastics. Its consistency makes it suitable for pressure gun application, a more convenient procedure than with the conventional stick lubricant. According to the manufacturer, it has been the experience of some chemical plants that the new plug cock grease provides a single material which effectively replaces the numerous types of greases hitherto required for varied chemical services.

A similar silicone material suitable for the lubrication of glass and ceramic stopcocks is also available.

DOUBLE-ACTING ENGINE

A WEIGHT of only 5.1 lb. per horsepower is claimed for a new double-acting engine known as the Tarbor-Hedges recently announced by the Tabor Mfg. Co., 6225 Tacony St., Philadelphia, Pa. The secret of the new engine, which develops up to 32 hp. on two cylinders, is said to be the successful application of the double-acting principle whereby the two cylinders accomplish the work of four. Cooling problems, formerly difficult to solve in double-acting internal combus-

tion engines, have been eliminated according to the manufacturer by drawing off heat from inside the cylinders as well as outside, through conventional fins. Inside cooling is accomplished by drawing the carburetor air through the specially designed cylinders, thus proportioning the cooling air to the speed of the engine. The principle of allowing combustion to take place on each side of the piston head, instead of on one side only, has produced a saving of approximately one-third in weight and a considerable space saving, the engine requiring a space of but 26x26x21 inches.

IMPROVED FASTENINGS

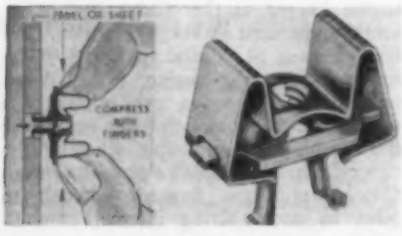
SEVERAL DEVELOPMENTS in specialized nuts have recently been announced by Tinnerman Products, Inc., 2115 Fulton Road, Cleveland 13, Ohio. One, known as the Hi-Stress Speed Nut, is a one-piece integral unit consisting of a base for attachment to any structure, out of which the nut section is pressed and threaded to produce a self-locking fastening element. It is claimed that this nut retains its self-locking torque even after many removals of the bolt.

Another new nut known as the floating cage type Speed Nut, shown in the accompanying illustration, can be attached to a panel or sheet without riveting, welding or spinning operations and without the use of special tools. All that is necessary is to compress the cage as shown and insert the legs into the clearance hole. The legs then spring apart when pressure is released, the turned-up ends holding the nut in place. The nut then holds tight against the force of inserting the screw and the screw- tightening torque. The new nut is claimed to be suitable for any type of blind attachment. It is made in both brass and spring steel, available with a standard 6-32 machine screw threads, or 6Z sheet metal screw threads. Larger screw sizes will be produced for industrial applications.

DRUM CARRIER

FOR the handling of heavy drums of chemicals, paints and similar materials, the Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia, Pa., has developed a removable drum and barrel handling device for attachment to its telescopic tilting fork trucks. As the accompanying illustration makes clear, the device consists of a pair of special short forks and a heavy metal loop which is dropped over the container by lever action after the forks have been slid underneath. It permits the operator to pick up the container and transport it in and out of cars and to storage, without stepping off the truck. The barrel handler is readily removed and the regular fork replaced for other handling functions.

Nut for blind attachments



DOUBLE-CYLINDER PUMP

A TWO-CYLINDER rotary pump of the radial vane type which can be used either as a multi-stage pump or as two separate single-cylinder pumps, while retaining the compact construction of a single pump, has been announced by Leiman Bros., 112-74 Christie St., Newark, N. J. The pump may be used for air pressure up to about 50 lb. per sq.in. or for vacuum up to about 28.7 in. Hg. One cylinder may be used for pressure and the other for vacuum or both may be used for pressure or for vacuum. One cylinder may be arranged in series with the other as a multi-stage pump for either pressure or vacuum, if desired. Smooth, quiet running and cool operation are claimed by the manufacturer. Various sizes are available for both pressure and vacuum.

BULK MATERIAL VALVE

ACCORDING to the manufacturer, many applications involving the flow of solid materials from bins, conveyors and spouts can be handled satisfactorily by the new bulk material valve recently announced by Stock Engineering Co., West 98th St. and Theodore Ave., Cleveland 2, Ohio. The new valve is suited for materials which are not too coarse to flow through a valve of this size and for materials which are not so fine and aerated as to flow into the pinions. In this valve the gate is made of ¼-in. steel plate, lapping the inlet nozzle of the body on all four sides in order to make an effective seal. This gate is carried on slide bars and is moved by racks on its under side, engaging pinions on the operating shaft. Racks and pinions are placed to each side to prevent the possibility of binding. The slide bars are made adjustable so that the valve clearance can be adjusted to suit the application. Wear can also be compensated. The operating shaft is extended on both sides so that the pocket sheave or handwheel may be assembled on either side as desired. The body is a one-piece close-grained grey-iron casting, ½ in. thick with ¾-in. thick flanges, of dust-tight construction. Valves are furnished in sizes from 6 to 12 in. with either round or square top and bottom flanges. Types are available for either vertical or inclined flow path.

Fork truck barrel carrier

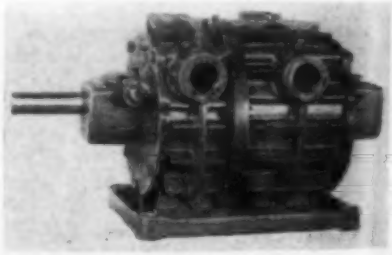
CONTROLLED VOLUME PUMP

DESIGNED especially for proportioning pump service against negative differential pressures, a new step-valve pump with outside spring-loading of the valves has been announced by Milton Roy Pumps, 1401 East Mermaid Ave., Philadelphia, Pa. This feature provides for ready adjustment to the desired load. A single cover plate is readily removable and provides complete accessibility without disturbing intake or discharge piping. The valve is said to afford complete freedom from air binding and to offer minimum restriction, since the liquid pumped moves in an almost straight line under the ball checks, rather than around them. This valve is available with pumps built by this manufacturer in capacities from 10 to 1,300 g.p.h., and is supplied for pumping materials, such as liquid latex, acid sludges, tars and asphalts.

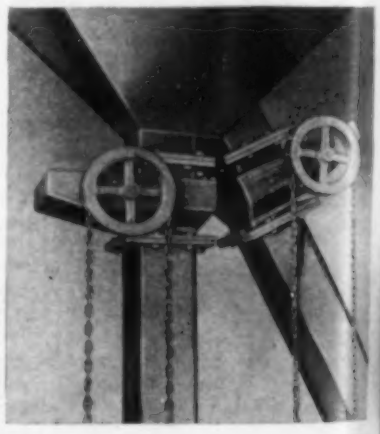
ELECTRICAL TACHOMETER

AN IMPROVED electrical tachometer for all types of speed measuring requirements is available from R. B. Brigham Co., 327 16th St., Toledo, Ohio. The new tachometer is of simplified design, consisting of a power unit with special sealed ball bearings and a permanent magnet rotor, built without brushes, commutators or gears. The indicating unit is housed in a hardwood case with a flexible cord and plug-in jack. Any type calibration may be had and direct scale readings up to 50,000 r.p.m. are possible. Accuracy of the indications is guaranteed to be within ½ of 1 percent of full scale.

Double-cylinder rotary air pump

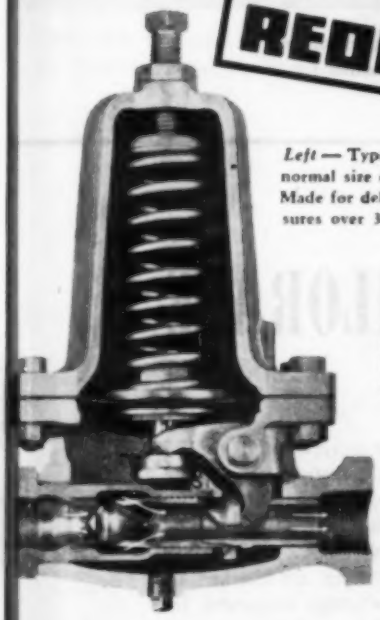


New bulk material valve



DAYS of able performance grow into YEARS

CASH STANDARD Streamlined PRESSURE REDUCING VALVES TYPE 1000



Left — Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.

Right — Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

The "1000" STREAMLINED Valve is a performer of top rank, rated on a basis of capacity — tight closing characteristics and close delivery pressure control.

The straight line flow promotes greater capacity — the "1000" is single seated and its valve makes line contact with its seat ring which accounts for its tight closing characteristics — the unusually long diaphragm spring insures sensitive pressure control and also a wide range of adjustment.

The benefits from this kind of top performance include: — practically zero in maintenance — elimination of failures —speedier production—smooth operation and no spoilage.

•

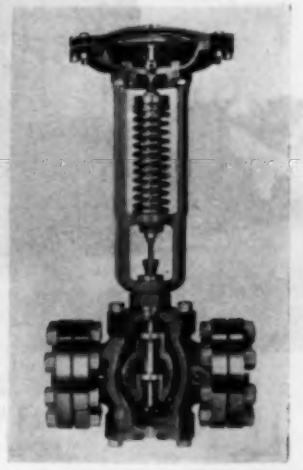
Write for Bulletin "1000" for full details.

•

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

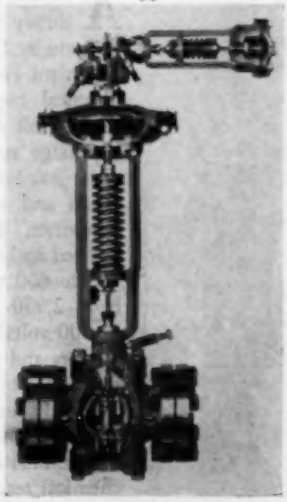
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble —no lost motion.

Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

☆



Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

☆

1 Modern plant at Portland, Ore., manufacturing sodium chlorate by electrolytic process. Raw material is solar salt from California

ELECTROLYTIC SODIUM CHLORATE

AN INTERESTING phase of western chemical industry has been the production of sodium chlorate by Pennsylvania Salt Manufacturing Co. in a plant embodying the latest developments in chemical engineering design at Portland, Ore.

Solar salt obtained from California is unloaded into large tanks and converted into a saturated water solution. Purification follows by precipitation and settling of calcium and magnesium impurities. The solution is clarified by filtration and fed to banks of electrolytic cells operating at 500 to 600 volts per series with current ranging from 2,000 to 3,500 amp. Power entering at 11,000 volts is stepped down by means of transformers and then converted to direct current by mercury arc rectifiers.

The formation of sodium chlorate by electrolysis of a brine solution is quite complex and is the culmination of a series of electrochemical and chemical reactions. Maintenance of high operating efficiencies depends on a number of factors such as temperature, hydrogen ion concentration, addition agents, etc. Usual current densities for producing sodium chlorate range from 74 to 185 amp. per sq.ft. giving an operating temperature of 85 to 90 deg. C. During this phase it is necessary to add sodium chloride continuously as sodium chlorate is quite soluble.

Cell liquors after electrolysis are clarified by filtration and fed to a two-stage evaporator for concentration, after which separation occurs in crystallizers with the sodium chlorate crystals passing to refining tanks for treatment. Final separation is obtained by use of batch centrifuges. The mother liquor is returned to the cell feed tanks for adjustment to final strength and volume. Drying of the crystals takes place in heated-air rotary dryers from which the material passes to grinding, screening and packing operations all of which are protected by dust control equipment. Safety has been stressed in all plant operations and many precautionary steps have been taken. Numerous jump tanks have been installed and the clothing of all workers in contact with the chlorate is washed daily in a modern laundry in the plant.

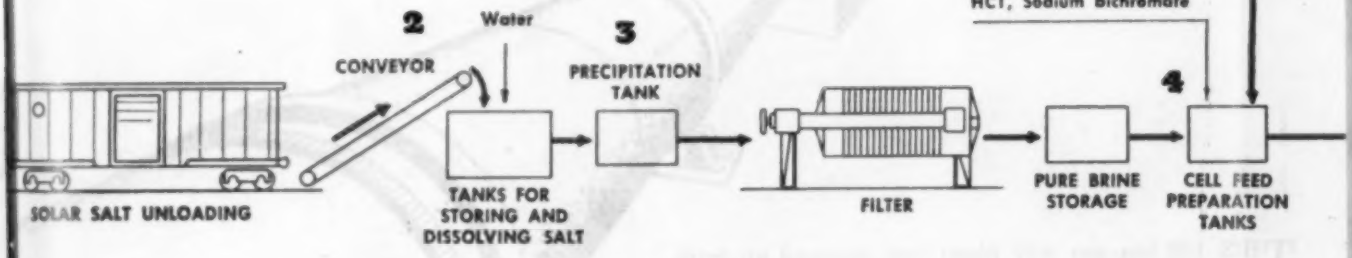
CHEMICAL & METALLURGICAL ENGINEERING

November, 1944

PAGES 130 to 133

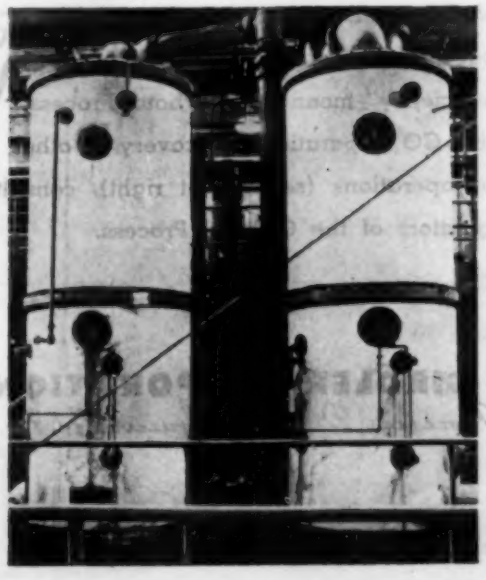
Solar salt is stored in tanks and later dissolved in water to form saturated brine. As needed the process, brine is pumped from tanks to the purification unit shown in illustration 3

4 In these tanks pH o yield of chlorate. Bic

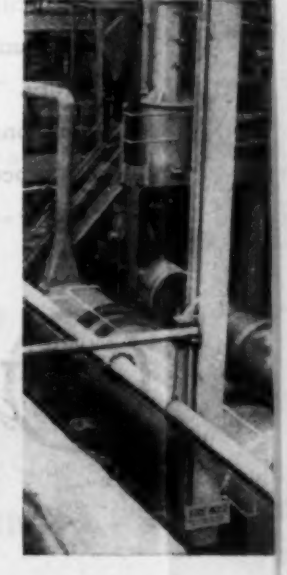


a and Mg salts are precipitated in concrete s; filters remove suspended matter

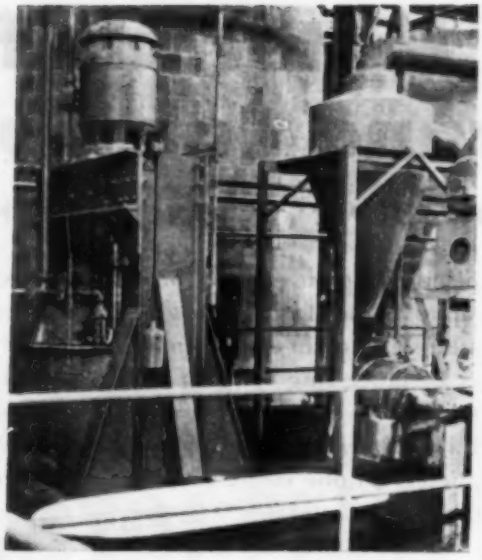
5 Electrolyzed and filtered, liquor is concentrated in this two-stage evaporator



7 Sodium chlorate cr rotary hot-air dryers i

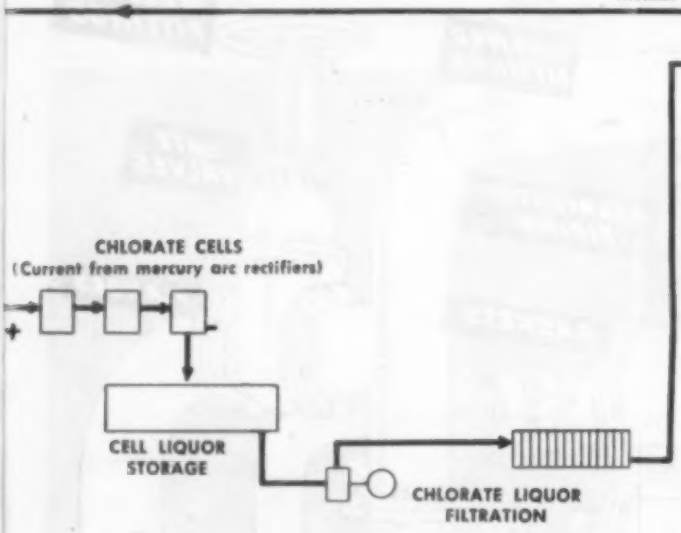


f feed liquor is adjusted with HCl to get optimum
hromate is added to inhibit corrosion



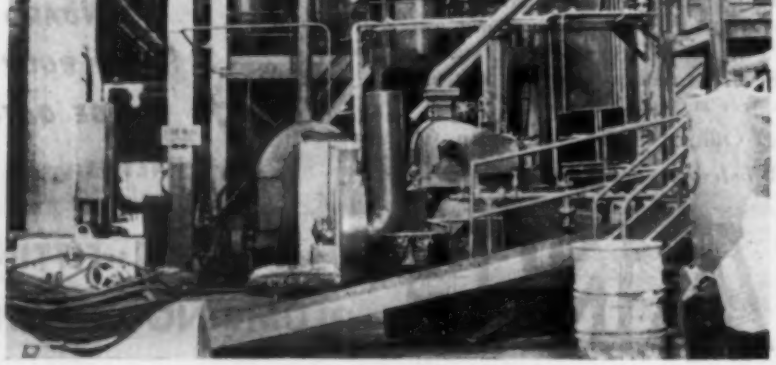
6 Centrifuges where crystallized sodium chlorate is separated from mother liquor

8 Over-all view
trusses are reflec

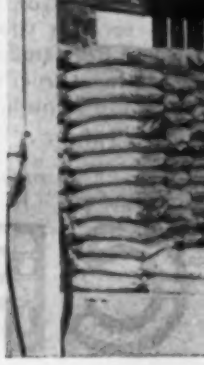


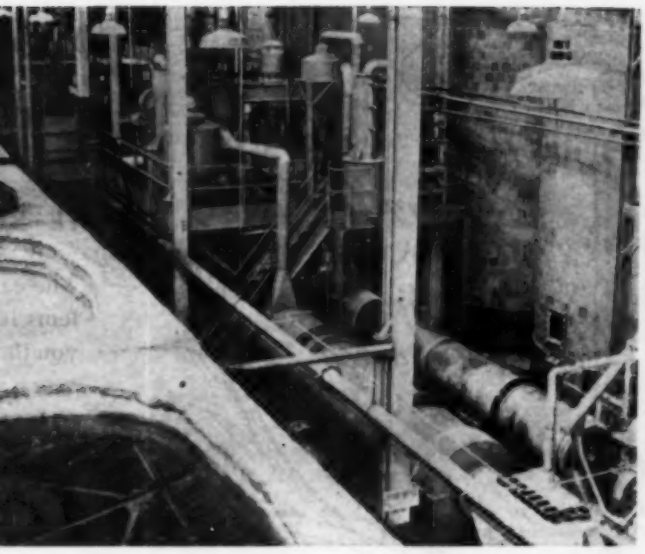
ystals are dried by
n foreground

9 Labyrinth of equipment seen in this end view emphasizes compactness which can be engineered into chemical process installations

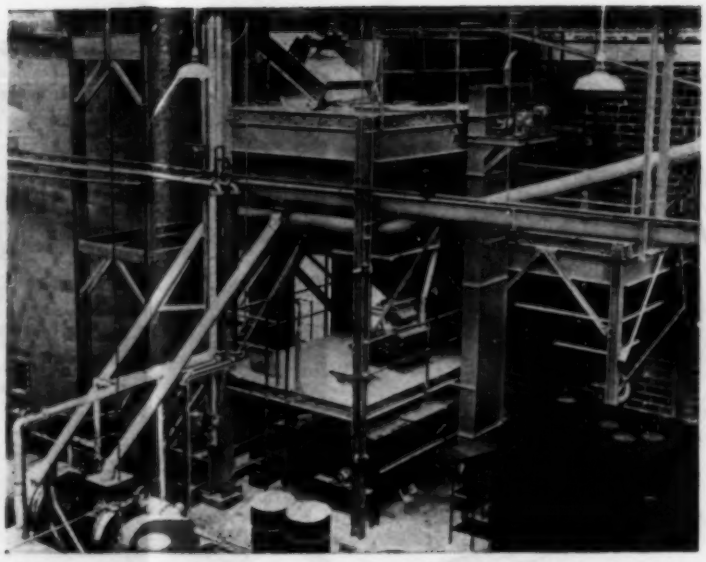


11 Sodium chl
while it awaits

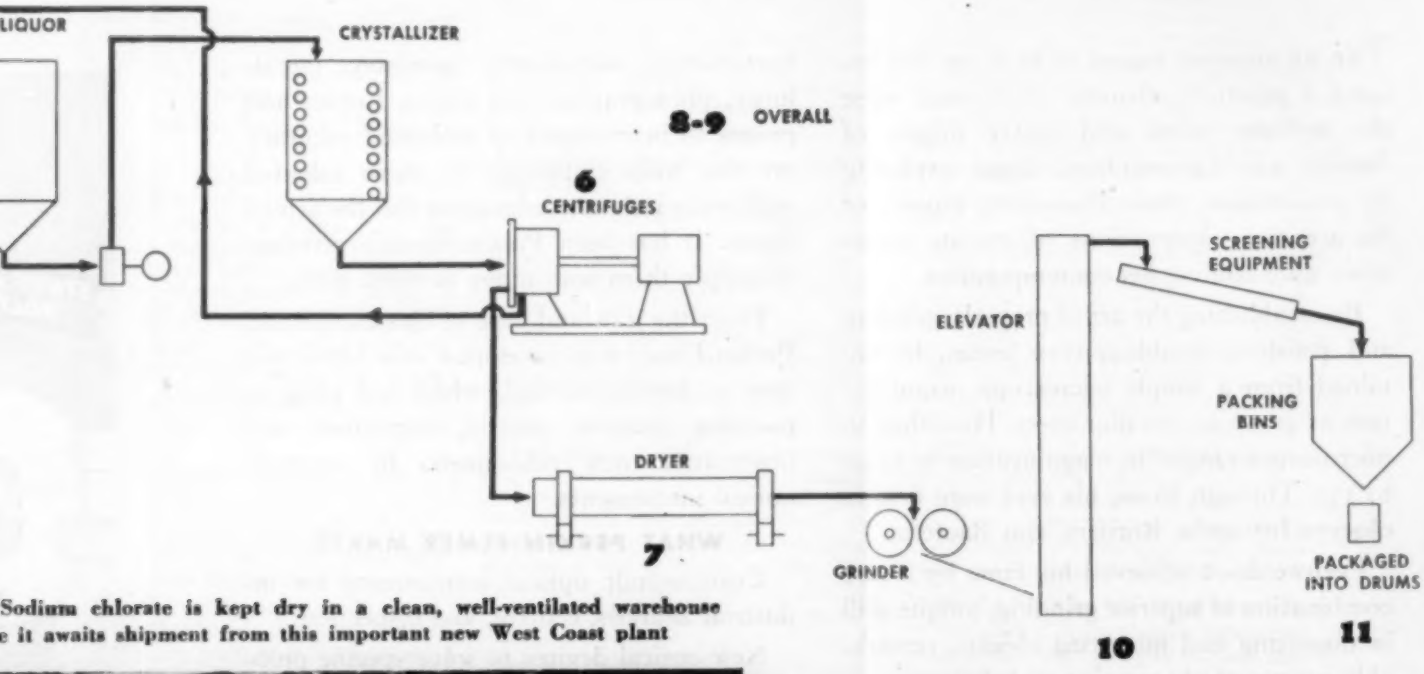




Over-all view shows feed tanks, centrifuges and dryers; roof
es are reflected in clear solution in foreground tank



10 Dust-free grinding, screening and packaging in this all-inclosed unit constitutes final step in the manufacturing process



Sodium chlorate is kept dry in a clean, well-ventilated warehouse
e it awaits shipment from this important new West Coast plant

A
Chem & Met
FLOW
SHEET

THE MICROSCOPE ceased to be a toy and became a practical scientific instrument when the brilliant mind and clever fingers of Antony van Leeuwenhoek began exploring its possibilities. Soon thereafter, reports of his accurate observations of minute structures were baffling his contemporaries.

By establishing the art of properly grinding and polishing double-convex lenses, he obtained from a simple microscope magnification as great as 160 diameters. His other 26 microscopes ranged in magnification from 40 to 133. Through these, his eyes were first to observe Infusoria, Rotifers, and Bacteria.

Leeuwenhoek achieved his fame by a rare combination of superior grinding, unique skill in dissecting and mounting objects, remarkable powers of observation and deduction.

HIS DISCIPLES STILL PROBE THE UNKNOWN

Today, modern disciples of Leeuwenhoek are combining accurate lens grinding and observational skill to probe the unknowns of bacteriology, astronomy, chemistry, metallurgy, photography, and vision. Lenses and prisms in instruments of increased accuracy are the tools employed by these talented workers in industry, education and the armed forces. It has been Perkin-Elmer's privilege to supply them with many of these tools.

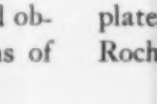
From the give-and-take of this experience, Perkin-Elmer has developed new ideas and new production methods which will bring to post-war analysis, control, inspection, and observation new refinements in scientific optical instruments.

WHAT PERKIN-ELMER MAKES

Custom-built optical instruments for industrial analysis, control, and inspection.

New optical devices to solve specific problems, such as the all-purpose infra-red spectrometer.

Special elements such as fine lenses, prisms, flats, photographic objectives, interferometer plates, retardation plates, Cornu prisms, Rochon prisms, Nicol prisms.



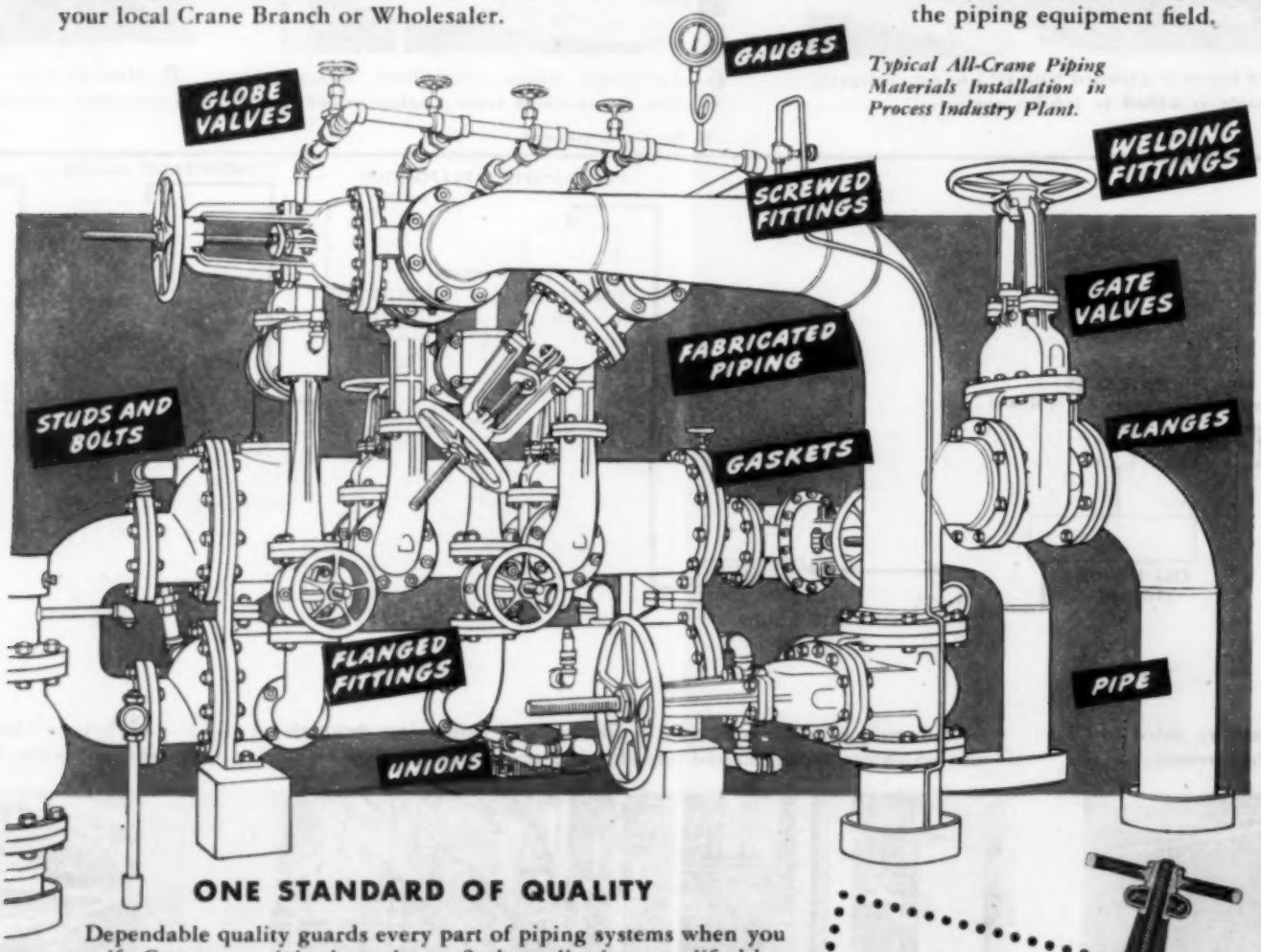
THE PERKIN-ELMER CORPORATION
GLENBROOK · CONN·

Piping Materials for Any Need ...Crane Can Supply Them

ONE SOURCE OF SUPPLY . . . ONE RESPONSIBILITY FOR ALL EQUIPMENT

The easiest way to dispose of piping supply problems is to put them up to Crane. Doing that gives you the world's greatest selection of equipment for every service—power or processing systems, high or low working pressures. All your needs of valves, fittings, pipe, fabricated assemblies and piping accessories are supplied from one single source—your local Crane Branch or Wholesaler.

Now when you are trying to catch up with deferred maintenance, Crane *complete* piping materials service is a big advantage. From ordering to installation, every step of the job is simplified. And while one responsibility for materials helps assure the best installations, you are also getting full benefit of Crane Co.'s 89-year experience and leadership in the piping equipment field.



Typical All-Crane Piping Materials Installation in Process Industry Plant.

ONE STANDARD OF QUALITY

Dependable quality guards every part of piping systems when you specify Crane materials throughout. Such quality is exemplified by Crane Iron Body Wedge Gate Valves. Strong body sections resist severest strains. Straight-through ports permit unrestricted flow. A deep stuffing box lengthens packing life. Long guides keep disc travel true, while the finest design in every part assures long life and smooth, trouble-free service.

Crane Co., General Offices: 836 S. Michigan, Chicago 5, Ill.

Branches and Wholesalers Serving All Industrial Areas

CRANE

VALVES • FITTINGS • PIPE

PLUMBING • HEATING • PUMPS

CHEMICAL SHOW

(Continued from page 115)

meters of various kinds including a new infra-red instrument and a quartz spectrophotometer. The latter is used primarily in vitamin A analysis and in the analysis of butadiene.

New: Based on a large number of installations of its earlier infra-red spectrophotometer, the company has developed a new model for qualitative and quantitative analysis of hydrocarbons. The new instrument includes a new energy-receiving system employing a palladium bolometer and vacuum tube amplifier; an electronically stabilized Nernst glower as a source of radiation; a continuous wavelength scale covering the range from 1.0 to 15 microns with a 17-position stop mechanism for routine analysis, and a motor drive for automatic continuous scanning.

The Ohio Steel Foundry Co., Lima, Ohio.

Exhibited: Fahrite alloy steel castings for corrosion resistance.

Olson Filtration Engineers, Chicago 39, Ill.

Exhibited: This company's cleanable filters designed primarily for the filtering of metal working coolants, but also adapted to other purposes. The filter elements consist of coiled springs which by adjustment of the tension may be set to give any desired aperture.

The Permutit Co., New York 18, N. Y.

Exhibited: This company's ion-exchange demineralizing process for the production of water of substantially distilled quality.

The Pfaudler Co., Rochester 4, N. Y.

Exhibited: Glass-lined steel, and stainless steel pilot plant units typical of this company's line of laboratory, pilot plant and commercial process equipment.

New: This exhibitor showed a new line of acid-resisting, glass-lined, heavy-duty valves now available in the flush, pop safety, globe and line types in sizes from ½ to 3 in., for use at high temperatures and pressures under corrosive conditions. The valves have porcelain seats and plugs which can be reground and fitted, simply by turning a grind-in wheel. In addition, the company displayed several new types of stainless steel shell and tube heat exchangers in internal floating head, packed floating head and fixed header designs.

Pressed Steel Tank Co., Milwaukee 14, Wis.

Exhibited: Light-weight compressed gas cylinders of low and high pressure types, as well as drums and barrels designed for the shipment of special chemical products. Among the types of containers shown were those for various gases, sulphuric acid, aqua ammonia, caustic potash, and other materials.

Productive Equipment Corp., Chicago 11, Ill.

Exhibited: Screening equipment shown in operation and by photographic illustrations. A stainless steel Selectro vibrating screen for wet operation was shown.

Proportioneers, Inc., Providence, R. I.

Exhibited: Three-dimensional flow diagrams of industrial processing applications of this company's proportioning equipment, such as blending of ingredients for the manufacture of plastics and synthetic rubber, lubricating oils, base stocks for aviation gasoline, and others. Working models of a flow-responsive Treet-O-Unit and Treet-O-Control meters were shown.

New: This exhibitor showed a new Adjust-O-Feeder constant-rate proportioning pump with a plastic cylinder.

E. H. Sargent & Co., Chicago, Ill.

Exhibited: A variety of laboratory instruments and equipment including an Heyrovsky polarograph, constant temperature equipment, electrolytic analyzers, pH meters, oven furnaces and balances.

Claude B. Schneibel Co., Detroit, Mich.

Exhibited: An operating model of this company's Multi-Wash dust collector, constructed with a glass shell to illustrate the principle; also enlarged photographs showing installations of collectors.

The Selas Corp. of America, Philadelphia, Pa.

Exhibited: Gas burning equipment and micro-porous ceramic filters for various purposes, including phase separation of liquids through application of controlled surface tension phenomena.

New: This exhibitor demonstrated a new application of the phase separation equipment mentioned above, a new device known as the Liqui-jector which has the function of removing liquid water in the form of mist or droplets from compressed air or other gases. This device employs two ceramic filters, one hydrophilic through which the separated water discharges continuously without permitting discharge of the air or gas; and the other hydrophobic, through which the dried air or gas passes without permitting passage of the liquid water.

Simplicity Engineering Co., Durand, Mich.

Exhibited: A totally inclosed 2 ft. by 3 ft. double-deck screen, designed to handle fine screening of either dry or liquid products.

Sparkler Mfg. Co., Mundelin, Ill.

Exhibited: A variety of filters and filter accessories including a filter with glass side walls to permit ready visualization of the principle of filtration, as well as an all-stainless steel production model filter and a number of filter plates of various materials.

New: This exhibitor demonstrated a new scavenger plate arrangement for its filters and a new type of stainless steel filter plate construction.

D. R. Sperry & Co., Batavia, Ill.

Exhibited: A variety of process plant equipment, particularly filter presses and filter media.

New: This exhibitor showed a new electric hydraulic closing device for filter presses which is readily attached to existing filters. It is said to permit the press to be controlled by girl operators, speeding the filtration cycle, preventing slamming and resultant damage to the filter cloths and simplifying the entire operation. The mechanism permits the filter press head to be actuated in either direction by simple manipulation of a switch.

Triangle Package Machinery Co., Chicago 51, Ill.

Exhibited: A variety of packaging equipment including a volumetric filler for chemicals, drugs, pharmaceuticals, food and soap products, producing packages ranging from a few grams up to 3 or 4 ounces, at the rate of 60 fillings per min.

New: This exhibitor showed a new automatic auger packer for powdered materials such as insecticides, drugs and pharmaceuticals, to be filled into cartons, bags, cans or bottles ranging from 2 oz. up to 5 lb. The machine features several improvements which reduce operator fatigue and increase production 25 percent.

Tri-Clover Machine Co., Kenosha, Wis.

Exhibited: Various types of stainless steel fabricated fittings suitable not only for use in handling dairy products but also other food products and synthetic latex.

Union Bag & Paper Corp., New York, N. Y.

Exhibited: Paper bags for the packaging of chemicals, with special emphasis on bags of the multi-wall type. A feature was a practical demonstratoin of the strength and quality of the high-wet-strength papers used in multi-wall bag construction.

Wallace & Tiernan Co., Newark 1, N. J.

Exhibited: Demonstration of improvements in products and profits that follow installation of chlorine and other chemical control apparatus, including savings in fuel, labor and lost time, with greater yields and better working conditions.

Waukesha Foundry Co., Waukesha, Wis.

Exhibited: This company's ball-bearing all-purpose sanitary pump of stainless steel constructon. The pump is a positive displacement type. The exhibitor also showed V-belt type drive units and variable-capacity units equipped with a variable speed drive.

Worthington Pump & Machinery Co., Harrison, N. J.

Exhibited: Two of this concern's acid-resisting Worthite centrifugal pumps, indicating the wide range of capacities and applications available. In addition the adaptability of Worthite to other uses was indicated in a display of bolts, nuts, valves, bars, etc. Pump parts having non-metallic corrosion-resisting coatings were also shown.

New: The concern has recently developed corroson resisting steam-jet ejectors constructed of porcelain and Karbate, singly and in combination, in single, two and three stage types. A three stage unit was shown. The new types find application in numerous war-time uses, including handling HF.

NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

CONTENTS

Tetra- & Pentachlorcumene	138
Cellulose Ethers	138
Sodium Furoate	138
Acetyl Peroxide	138
Dry Sodium Methylate	138
Trimethylolpropane	140
Shrinkage-Control Resin	140
Aliphatic Acids	140
Textile Flameproofer	142
Ceramic Wire Insulation	142
Domestic Fuel	142
Floor Material	143
Plastic Foam	143
Phenolic-Type Resins	143
Metal-Working Oil	144
Synthetic Soles for Shoes	144
Dimethylethanolamine	145
Benzene Sulphonchloride	145

TETRA- & PENTACHLORCUMENE

As COMPANION products to trichlorcumene (*Chem. & Met.*, October, 1944, p. 149) Hooker Electrochemical Co., Niagara Falls, N. Y., offers experimental quantities of tetra- and pentachlorcumene. Tetrachlorcumene above its melting point is a colorless, mild smelling liquid of low viscosity and extremely high stability. It may be distilled at atmospheric pressure without decomposition. When blended with 20 percent pentachlorcumene it melts at 8 deg. C. and boils at 290. It is suggested for use as a plasticizer, a fire-safe dielectric, an extreme pressure lubricant, and a heat transfer fluid.

Pentachlorcumene is a hard, white, crystalline wax, also possessing a mild odor and also extremely stable. In addition to the uses suggested for tetrachlorcumene, it is recommended as a fire and water resistant, and as a textile impregnating agent particularly when blended with a softening agent.

Properties of Tetrachlorcumene

Formula	$C_3H_7C_6HCl_4$
Molecular weight	258
Melting range, deg. C.	15–25
Boiling range, deg. C.	280–295
Flash point, deg. C.	155–160
Fire point	None
Hydraulic stability test mg. Cl_2 per ml. sample	below 0.05
Soluble in benzene and most chlorinated solvents	
Insoluble in water	

Properties of Pentachlorcumene

Formula	$C_3H_7C_6Cl_5$
Molecular weight	286.5
Melting range, deg. C.	70–85
Boiling range, deg. C.	300–325
Flash point, deg. C.	175–180
Fire point	None
Hydraulic stability test mg. Cl_2 per ml. sample	below 0.05
Soluble in benzene and most chlorinated solvents	
Insoluble in water	

CELLULOSE ETHERS

Two NEW cellulose ethers have been added to the long list already available from the Dow Chemical Co., Midland, Mich. They are Carboxymethocel S and Carboxymethocel A. Used as thickeners, emulsion stabilizers, and suspending agents in either aqueous or dilute alkaline media, these derivatives are said to possess properties which suggest wide applicability in the paper, paint, textile, cosmetic and pharmaceutical industries.

Carboxymethocel S is soluble in hot or cold water. Carboxymethocel A is insoluble in water but soluble in dilute solutions of many alkaline reagents. Both are insoluble in most organic solvents and are unaffected by oil or grease of animal, vegetable, or mineral origin. Great importance is attached to the fact that solubility characteristics are unaffected throughout a broad temperature range. Film forming properties are excellent. Used in sizings and coatings, they imbue the product with great stability to the action of light, heat and bacteria.

They are currently offered in a range of viscosity types: low viscosity for solutions of high solid concentrations such as sizings and coatings; and high viscosity for its effectiveness as a thickener and suspending agent.

SODIUM FUROATE

SEMI-COMMERCIAL quantities of sodium furoate are available from the Quaker Oats Co., Chicago, Ill. At the moment, principal interest in the new product seems to be as a convenient source of furoic acid, but it is also applicable as a preservative and in the synthesis of furoic acid esters and other derivatives.

Properties of Sodium Furoate

Physical form	White powder
Moisture, percent, max.	1
Sodium chloride, percent, max.	0.5
Formula	$C_4H_3OCOONa$
Molecular weight	134.0
pH of molar sol.	8.6
Solubility — g. per 100 g. solvent:	
Water @ 20 deg. C.	66
Water @ 90 deg. C.	80
Methanol @ 20 deg. C.	4.5
Ethanol @ 20 deg. C.	0.9
Insoluble in ether, acetone, chloroform, petroleum ether, and benzene.	

ACETYL PEROXIDE

ALTHOUGH this potentially useful chemical was first prepared as long ago as 1863, it has never achieved commercial importance because of its sensitive and violently exposive nature. Now the Buffalo Electro-Chemical Co., Buffalo, N. Y. announces that it is able to supply acetyl peroxide in a form which can be handled commercially with complete ease and safety. Since 100 percent acetyl peroxide cannot be shipped used, or even manufactured on a lar scale, it has been necessary to put it o the market as a 30 percent solution i dimethylphthalate. In this form it is water-white, non-explosive liquid, immun to shock and impact.

Found to be one of the outstandi polymerization catalysts, this "new" chem ical seems assured of a place in the produc tion of synthetic plastics and elastomer Other proposed applications include i use as a germicide, a bleaching and oxidi ing agent, and in vulcanizing.

Because of war-time restrictions th manufacturer can at present supply acet peroxide only in research quantities, bu as soon as equipment is again availabl he expects to produce in commercia quantities.

Properties

$C_4H_6O_4$ content, % by wt.	
Active oxygen content, % by wt.	
Color	Crystal cle
Specific gravity	1.1
Flash point (open cup), deg. C.	
Solubility	All proportions in many organic liquids such as acetone, ether vegetable and mineral oils, meth methacrylate and most monomers.

DRY SODIUM METHYLATE

THIS VERSATILE reagent is now availabl in commercial quantities from Mathieso Alkali Works, New York, N. Y. Unt now it has always been necessary for th consumer to produce his own sodiu methylate "on the spot" by reactin sodium and methanol—a slow and dange ous process. Moreover, the best produc obtainable, a dilute solution of sodiu methylate in methanol, was unsatisfactor for many purposes.

The new product is a fine, white, ve hygroscopic powder with the average com position: sodium methylate (CH_3ONa) 95 percent; sodium hydroxide plus sodiu carbonate, 2 percent; methanol, 3 percen It is stable as a saturated solution i methanol or when kept in airtight con tainers. However, when the powder i exposed to the air it decomposes—slowl at room temperature and more rapidly a elevated temperatures—and above 125 de C. it is likely to char.

In its present form sodium methyla may find wide acceptance in a variety o organic syntheses. In many of these re actions its function is essentially catalyt in that its presence is necessary to effe the synthesis. Unlike a true catal however, it breaks down during the pr cess, forming sodium hydroxide an methanol. In other reactions it acts a source from which it is possible to rele either sodium or the methyl group ont the organic molecule being built up. A a heretofore-restricted wartime product

has already revealed its usefulness as an important factor in the spectacular development of the sulfa drugs, vitamins, dyes and perfumes.

TRYMETHYLOLPROPANE

TMP, AS IT IS CALLED, is a new polyhydric alcohol now available in commercial quantities from the Heyden Chemical Corp., New York, N. Y. Esters made with rosin and TMP are soluble in mineral spirits and have good compatibility with drying oils and nitrocellulose, so that they may be used for the preparation of spirit, oil, and nitrocellulose lacquers. Its resins are said to have considerably higher stability to light than the usual ester resins from rosin and other polyhydric alcohols.

Trimethylolpropane has already found uses in making low-viscosity drying and non-drying alkyd resins. These alkyds have shown application in the manufacture of textile printing pastes and impregnants. TMP is also used in the manufacture of synthetic drying oils, coating compositions and plasticizers. In general, wider solvency and combatibility are exhibited in oils and resins made from the new product.

Properties of Trimethylolpropane

Appearance	Crystalline waxy solid
Formula	$C_6H_{11}(OH)_3$
Molecular weight	134.17
Hydroxyl content (percent OH)	33.5
Combining weight	50.8
Color (Gardner)	11
Solubility—g. per 100 g. solvent at 25 deg. C.	
Water	All proportions
Ethyl alcohol	All proportions
Glycerol	All proportions
Benzene	0.02
Acetone	71

SHRINKAGE-CONTROL RESIN

SUPPLYING protection against repeated dry cleaning and laundering, Lanaset, a synthetic resin, preserves the original appearance and dimensions of woolen fabrics. Produced by Calco Chemical Division of the American Cyanamid Co., Bound Brook, N. J., the product is a melamine resin and has, according to the manufacturers, already been tested by a number of mills and finishers. Lanaset has also been used by the U.S. Army Quartermaster Corps for testing three-quarter million yards of wool sleeping-bag fabric.

Unlike usual chemical methods for controlling shrinkage, Lanaset does not actually alter the wool. It is an additive and stabilizes wool and wool blends without affecting their characteristic absorbency. It also reduces felting, and prevents pilling and fuzzing. Wool treated with the product has a higher resistance to alkali than untreated wool.

The resin is applied simply by passing the fabric through an aqueous bath containing the resin. The fabric is then squeezed uniformly through a mangle, dried and heat cured, and given a light wash to remove surface resins. Application is permanent for the life of the fabric.

ALIPHATIC ACIDS

SHORTER-CHAIN-LENGTH fatty acids which are not available in nature will soon be produced on a commercial basis by Emery Industries, Inc., Cincinnati,

Drawn from life—running a test at the General American Process Equipment Laboratory, in one of the semi-plant scale Louisville Dryers.

FINEST ENGINEERING—PLUS!

It's one thing to talk about efficient performance in process equipment—another thing to deliver it. General American Process Equipment does deliver. It is designed by outstanding engineers whose talents are known and trusted throughout the process industries. *But our organization nevertheless operates a complete pilot-plant Testing Laboratory as a basis for its engineering recommendations, and to make doubly sure that your equipment will perform as planned.*

We'd like an opportunity to demonstrate what this kind of engineering PLUS can mean to *you*.

* * * * * * * * *

GENERAL AMERICAN PROCESS EQUIPMENT DIVISION GAT-X GENERAL AMERICAN

General American Process Equipment is a consolidation of four outstanding process equipment manufacturers, each a well-known specialist in its field, now welded together to serve you with one organization, one responsibility and one high standard of performance.

This Division is also closely associated with the Plate and Welding Division of General American Transportation Corp., at Sharon, Pa.

GENERAL AMERICAN PROCESS EQUIPMENT

A Division of General American Transportation Corporation

Executive Offices: 425 BAXTER AVENUE, LOUISVILLE 4, KENTUCKY

New York Office: 420 LEXINGTON AVENUE, NEW YORK 17

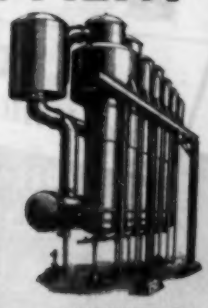
FRACTIONATING COLUMNS, PRESSURE VESSELS

TURBO-MIXERS, AGITATORS, AERATORS

CONKEY VACUUM AND PRESSURE FILTERS

AMERICAN DRUM DRYERS AND FLAKERS

LOUISVILLE DRYERS, COOLERS, KILNS



CONKEY VACUUM EVAPORATORS

Ohio. A new plant is nearing completion and will shortly be turning out two commercially new acids.

In one of these aliphatic acids, pelargonic acid predominates in a mixture of monobasic acids. Its esters are, in general, more compatible with synthetic resins than are the esters of higher molecular weight acids. The makers, then, suggest their use as plasticizers.

A dibasic acid, azelaic acid, is the other. It reacts with monohydric alcohols to form relatively high boiling esters. It forms soft alkyd resins when combined with glycerin and other polyhydric alcohols.

TEXTILE FLAMEPROOFER

THE NAME of a new and versatile flameproofing compound now available from the Talco Corp., Hoboken, N. J., is Pyropruf. This material is used in the treatment of clothing and all light- and heavyweight fabric. Although it differs from the usual flameproofer, in that it is organic in nature, it is said to meet the efficiency and composition requirements of U. S. Navy specifications.

The product can be pigmented, permitting simultaneous dyeing and flameproofing; and further, it is compatible with agents for mildew and fungi control, so that these may also be applied in a single operation. Pyropruf allegedly has no detrimental effect on the fibers, either natural or synthetic, and once applied, it is not excessively removed by repeated laundering or dry cleaning.

CERAMIC WIRE INSULATION

"SMALLER-SIZED equipment can be designed to do larger jobs" by using a new ceramic, and entirely inorganic, coating material for insulating copper, nickel and other types of electrical wire. That is the claim made by the Sprague Electric Co., North Adams, Mass., for its new product, Sprague Ceroc 200. Because the insulation maintains "desirable electrical characteristics at a continuous operating temperature of 200 deg. C. as compared to the present limit of 105 for conventional Class A insulations," and because the preferred thickness is only ¼ mil (0.0064 mm.), it is possible to increase very substantially the volt-ampere rating for motors, transformers, choke coils and similar equipment wherein it is used.

DOMESTIC FUEL

SHIVERING householders may expect partial relief from the fuel shortage as soon as a plant can be erected at Philadelphia for the processing of a new fuel briquette. Composition of the briquettes will be the usual mixture of anthracite fines, bituminous fines, and asphalt binder; but a novel feature will be introduced by wrapping up six 3-in. cubes in paper to form a clean, easily handled package. To be known as "white glove" fuel because of its cleanliness, it can be burned efficiently without any changes in furnaces or stoves, and from extensive tests it is found to meet existing smoke abatement regulations.

The plant which will make these cubes will be financed by the Defense Plant Corp. and will be erected and operated by Blaw-Knox Co. It will have an annual

capacity of 150,000 tons and will use approximately 120,000 tons of anthracite fines, the difference being the bituminous fines and asphalt binder.

FLOOR MATERIAL

INSTALLING a new floor over old cement need no longer involve lengthy preparation of the subfloor, nor application of adhesives, according to the manufacturers of Stonoleum, a flooring material that is self bonding. This product can be laid over old concrete, cement, wood, or composition without adhesives or separate bonding agents.

The flooring material, according to the makers, feels like rubber and wears like stone. A colloidal composition gives it greater resistance, not only to direct impact and load, but also to continuous vibration, abrasion and other effects of traffic.

Another feature is its self-healing characteristic. Small holes in a Stonoleum floor, such as those left when machines or fixtures are removed, disappear under traffic. Continental Asbestos Refining Corp., New York, N. Y. manufactures this material, and suggests that it also be used as a patch material.

PLASTIC FOAM

WEIGHING only one-seventh as much as cork, a plastic foam has been developed and is being manufactured by the United States Rubber Co., New York, N. Y. Known as Flotofoam, the material is bouyant, yet semi-rigid. According to the manufacturers, it has good insulation and sound-deadening properties in comparison to its weight, because it contains so much air space. Actual weight is less than 1.5 lb. per cu. ft.

Now used in various war instruments and industries, the plastic foam is expected to find use in such peacetime equipment as trains, airplanes, automobiles, life preservers, floats and bouyancy units on pleasure craft.

PHENOLIC-TYPE RESINS

TWO NEW phenolic-type resins have been announced by U. S. Industrial Chemicals, Inc., New York, N. Y. Both of these resins were developed for present-day use with "soft" oils, and both are currently available for many civilian end-uses, although application must be made as usual under WPB Order M-246.

S&W Arochem 337 is recommended for use in quick-drying varnishes, quick-drying enamels for either general or industrial use, floor paints, spar varnishes, over-print varnishes, and printing inks. In varnishes of equivalent oil lengths this high melting point, modified phenolic is said to enjoy superiority over other resins of its type by virtue of its ability to impart faster bodying rate, faster drying properties, better resistance to alkali and water, and greater film hardness and mar resistance.

Since it is readily soluble in most high-viscosity oils without special processing, it is easily handled in spite of its high melting point. In nearly all cases the total resin and oil content may be charged into the kettle at the outset and taken to top heat without any "kickout" or

formation of gel particles. Due to the short cooking schedules required, varnishes made with S&W Arochem 337 are light in color.

While this resin is too reactive to be used with tung oil alone, satisfactory varnishes may be produced by the addition of moderate amounts of less reactive resin or oil to the cook.

Specifications of No. 337

Acid number 30-40
Melting point (Hg method), deg. C. 150-160
Color ..... N-K
Specific gravity 1.1
Soluble in coal tar and petroleum hydrocarbons; in oils, both high and low viscosity.
Insoluble in ethyl alcohol.

S&W Arochem 338 is recommended for use in gloss ink vehicles and over-print varnishes as well as varnishes and enamels for general and industrial use. This is also a modified-phenolic resin, but has a higher melting point than S&W Arochem 337, and being less soluble in solvents and oils, it is more rapid in its bodying action. Manufacturing holding times are shortened because ink vehicles produced from it are of exceptionally high viscosity. Due to the unusually large molecular structure of the resin, the resulting vehicles dry to extremely hard, tough films with maximum "hold-out" and gloss.

In the production of varnishes and enamels, the resin usually requires special processing when used with most pre-bodied oils, and without modification, it is too rapid in its bodying action for use with oils like tung.

Specifications of No. 338

Acid number 25-35
Melting point (Hg. method), deg. C. 160-170
Color ..... N-K
Specific gravity 1.1
Soluble in coal tar hydrocarbons, lacquer solvents, low and medium viscosity oils.
Insoluble in petroleum hydrocarbons, ethyl alcohol.

METAL-WORKING OIL

To BREAK a bottleneck in the deep drawing of aluminum, the Shell Oil Co., New York, N. Y., developed an oil which incorporates good lubricating and cooling qualities with the ability to be washed away with warm water when the drawing operation is over. Combining the characteristics of water soluble oils with those of heavy-duty cutting oils, Shell Virgo Oil is "eminently suited for any drawing or cutting operation, with the possible exception of automatic screw machine use."

Virgo Oil is well behaved: it does not clog, smoke, foam, or turn sour and foul smelling. It can be used on almost all kinds of metals and alloys, and it permits heavy cuts and fast cutting speeds.

SYNTHETIC SOLES FOR SHOES

CLAIMING it will wear two to three times as long as the best leather or rubber soling now being used commercially, the B. F. Goodrich Co. of Akron, Ohio, announces its plans to market a complete line of shoe soling and toplifts made from Koroseal. In its new use Koroseal is said to possess properties, in addition to its wearing qualities, which give it a marked advantage over any other product now

being offered. It is non-marking, leaving no discoloring stain on floors. It will grip as well as leather or rubber even in wet weather. It will not pick up pebbles, gravel or other foreign substances. It is impervious to oil, water and grease, not absorbing any of these. It can be cleaned easily with a damp cloth. It is as comfortable and as cool as leather or rubber and is more flexible than leather. It will be available in a complete assortment of colors. The new soling will be sold only to the shoe manufacturer as cut soles which may be applied to the shoe by any of the conventional methods.

DIMETHYLETHANOLAMINE

THIS NEW addition to the family of ethanolamines, $(CH_3)_2NCH_2CH_2OH$, is produced by the Carbide and Carbon Chemicals Corp., New York, N. Y. It is a water-white, hygroscopic liquid with an amine-like odor; is completely miscible with water, alcohol, and benzene; and will undergo reactions typical of a tertiary amine. Since it contains a hydroxyl group, it also possesses the chemical properties of an alcohol.

Dimethylethanolamine is, according to the manufacturer, of value in the synthesis of compounds used as pharmaceuticals, corrosion inhibitors, acetate rayon dyestuffs, and textile auxiliaries and lubricants. Its p-butylaminobenzoic acid ester is a local anesthetic similar in effect to novocaine. As a corrosion inhibitor in steam systems it forms a constant boiling mixture with water in dilute concentrations, thereby maintaining a constant alkalinity in the boiling solution, vapor, and condensate. Its esters, as compared to the closely related esters of diethylethanolamine, are considerably more hydrophilic and show better color stability.

Properties of Dimethylethanolamine

Molecular weight	89.14
Specific gravity at 20/20 deg. C.	0.887
Boiling point at 760 mm., deg. C.	133.5
Solubility in water at 20 deg. C.	All proportions
Flash point (open cup), deg. F.	88
Refractive index at 20 deg. C.	1.4300
Average lb. per gal., 20 deg. C.	7.4

BENZENE SULPHONCHLORIDE

ITS COMMERCIAL possibiliities as yet unexplored, this comparatively obscure chemical is offered for investigation by the Wyandotte Chemicals Corp., Wyandotte, Mich. It is available in either refined or technical grades and its properties indicate that it should be of value in organic syntheses, and in the preparation of dyestuffs, tanning agents, pharmaceuticals, and plasticizers.

Having the formula, $C_6H_5SO_2Cl$, it undergoes most of the reactions of typical acid chlorides, but under certain conditions it acts as a chlorinating agent or as an oxidizing agent. It hydrolyzes slowly and enters into reactions with amines, alcohols, amides, reducing agents and others.

Properties (Refined Grade)

Molecular weight	176
Physical form	Water-white liquid
Purity, percent	97-100
Melting point, deg. C.	14.5
Distillation range, deg. C.	244-250
Water solubility	Very slight
Specific gravity @ 15 deg. C.	1.36
Weight per gal., lb. @ 25 deg C.	11.34

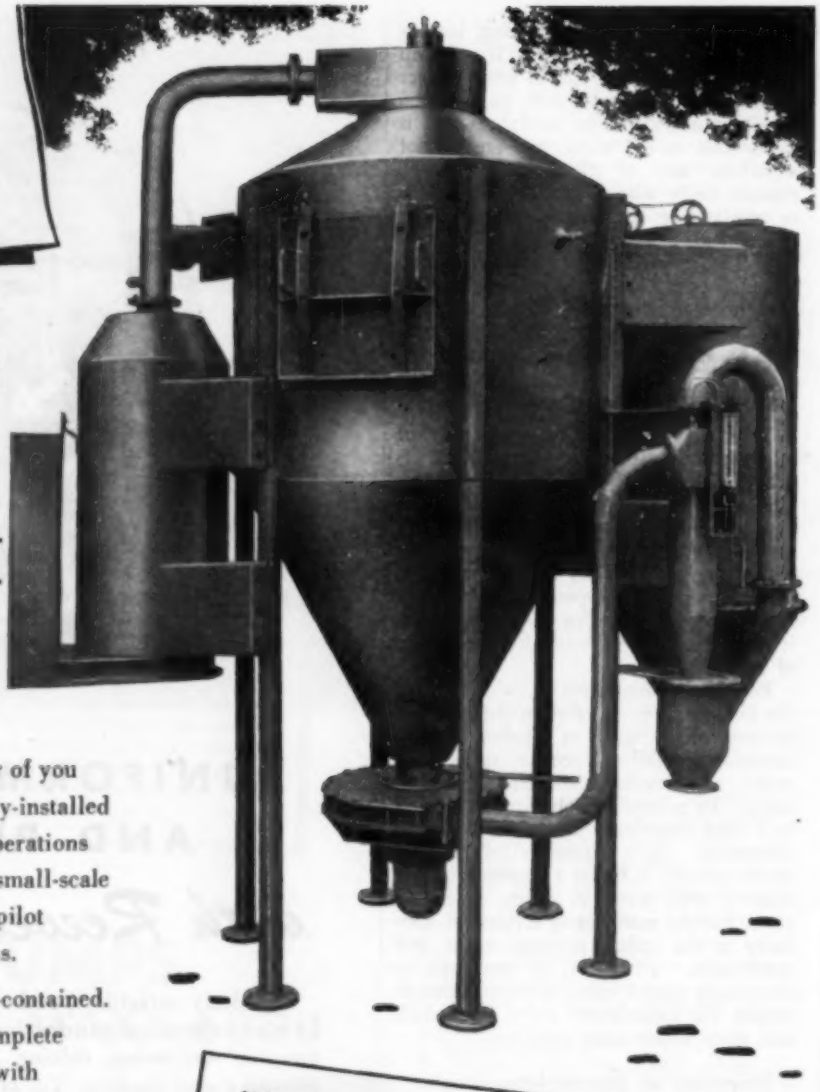
Advanced Information

on the

Newest Development in Spray Drying . . .

the TURBULAIRE TYPE N SPRAY DRYER

. . . an economical, compact, completely self-contained unit for small-scale drying operations!



HERE's the spray drying unit many of you have been waiting for . . . a compact, easily-installed unit capable of a wide range of drying operations on various types of products—either on a small-scale production basis or for investigation and pilot plant operations on spray drying problems.

The Type N TURBULAIRE is completely self-contained. In addition to the desiccating chamber, complete with blower, it also incorporates a heater with variable temperature control as well as a MULTICLONE Collector and a bag filter for recovering the dried material from the circulating gases.

Developed by the same group of engineers that perfected the famous TURBULAIRE Spray Dryer widely used on modern large-scale drying operations, the Type N incorporates many unique operating features. Send for bulletin which describes in greater detail this new advancement in the spray drying field.

IMPORTANT FEATURES OF THE TURBULAIRE TYPE N DRYER!

CONSTRUCTION: Four foot cylindrical desiccator chamber has cone bottom for collection of dried product and hand operated mechanism for sweeping surface accumulations from interior of chamber. Standard equipment includes electric heater, Multiclone Collector, fan, bag house and control instruments all unitized into one compact assembly. Only electrical, compressed air and feed connections need be made.

SIZE: Complete unit occupies a floor space of only 5' 0" x 9' 8" and with headroom of 10' 6"

ADAPTABILITY: Maximum operating flexibility is provided by optional heaters—either direct or indirect types—and secondary inlets for introducing tempering or precooled air. This permits handling thermoplastic and heat-sensitive materials as well as those which tend to case harden.

CAPACITY: The unit is rated at an evaporation of 25 pounds of water per hour at a temperature differential of 300°F. between inlet and outlet, but actual capacity may vary either above or below this figure depending upon exact nature of operation and material.

These are only a few highlights on the many features embodied in this new TURBULAIRE development. Write for literature which gives more complete details on the unit.

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1013 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 140 S. DEARBORN ST., CHICAGO 3
HOBART BUILDING • SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

READER'S VIEWS AND COMMENTS

BOUQUETS . . .

To the Editor of Chem. & Met.:

Sir:—We today received the September issue of your publication in which appears the Materials of Construction section.

The writer wishes to congratulate you upon getting out such a complete paper on corrosion. It unquestionably is the best article on this subject in existence today.

D. R. SPERRY, JR.

President
D. R. Sperry & Co.
Batavia, Ill.

. . . AND BRICKBATS

To the Editor of Chem. & Met.:

Sir:—This is the first time I have ever written a letter of protest to an editor; but when a supposedly technical journal such as *Chem. & Met.* allows such tripe as appears in Mr. Dan Gutleben's column to be published I think it is timely to point out to you the extremely bad taste. "Faithful Old Michel" and his peculiar personality (*Chem. & Met.*, Sept. 1944, p. 177) can hardly come under the heading of scientific knowledge, nor is the pathetic little story in the least bit humorous.

May I suggest that in the future you either keep Mr. Gutleben in line or keep his stuff out of your publication!

MARGARET P. HILLIGAN

Cuyanoga Falls, Ohio

SYNTHETIC vs. NATURAL

To the Editor of Chem. & Met.:

Sir:—The Committee on International Economic Policy in cooperation with the Carnegie Endowment for International Peace has issued two reports: "World Trade and Employment" and "The International Economic Outlook."

These reports are forward-looking and most liberal in their approach to the problems of postwar international trade. However, they fail to discuss one of the most important problems we shall face in the postwar period. This is the competition which the new synthetic products will offer to the older natural products. As a result of developments which have taken place during the past few years in the field of synthetics, we face an entirely different situation than the one faced prior to the present war. These changes must be given careful study and consideration in connection with any proposed solution of world import and export trade problems. Synthetic textiles, rubber, drugs, medicinals, insecticides, etc., may be in a position to compete with similar natural products without benefit of protective tariffs or subsidies.

For example, it has been stated that synthetic rubber can be produced in the United States for six cents per pound; a price which could permit direct competition with the natural product from the Dutch and British plantations in the Malay Straits. In general, we will have to

decide whether or not we wish to support the natural rubber industry at the expense of the already established synthetic rubber industry here in the United States. Our present production capacity for synthetic rubber is approximately 200,000 tons per annum in excess of our prewar consumption of natural rubber. Further in the case of natural rubber, if we import same, we will have the problem of selecting our source of supply, shall it be the Malay Straits or shall it be Brazil. Here we run into the problem of "Hemispheric Solidarity."

The problems which we face in connection with rubber are similar to those faced on down the line in the textile, drug, medicinal and insecticide field.

R. M. PALMER

Chemical Engineer
New York, N. Y.

PUMPS FOR H_2SO_4

To the Editor of Chem. & Met.:

Sir:—On page 95 of your September issue a design engineer is quoted relative to his experience in a rayon plant on handling sulphuric acid of various dilutions. That problem has certainly plagued every rayon manufacturer. At present, we find LaBour centrifugal pumps, with R-55 impellers, and Hastelloy shafts, give the most satisfactory service. However, pump packing for various dilutions of hot sulphuric acid, when pumps are operated under fairly high back pressures, becomes another problem—and not too satisfactorily solved.

We have had very poor experience with stainless steel equipment in contact with a low dilution of sulphuric acid where there is considerable aeration or where the solution is carrying appreciable quantities of iron salts.

CHEMICAL ENGINEER

CONTRIBUTING FACTORS

To the Editor of Chem. & Met.:

Sir:—Special congratulations on the September, 1944, issue of *Chem. & Met.* Corrosion data you have published during the past twenty-one years have been most valuable. The intimate contacts with actual operating conditions which the survey affords is by all means the best way of getting at the facts.

There is one typographical error: "Sulphide pulp," in the table on pages 97-98, should read "Sulphite pulp."

The remedy for any given corrosion problem can only be prescribed when all of the contributing factors are known. Too often, the operator states that a given material has failed without giving details of operating conditions. Such details should include operating temperatures and pressures, degree of aeration, percentage of water present in solutions, etc. The corrosive action of anhydrous acetic acid, acetic acid containing traces of water and acetic acid containing substantial amounts of water, varies over extremely wide limits. The same holds true for temperature variations. Too often, what seem to be conflicting reports have been rendered by operating personnel because some of the operating data were not given. For example, a given corrosion-resisting material may be reported as satisfactory for use with a given

corrosive acid by operator "A" while operator "B" will report the same material as being unsatisfactory for use with supposedly the same corrosive acid. Such conflicts of opinion generally rise through failure to recognize the fact that operator "A" is working under conditions somewhat different from those which "B" faces. The literature is full of references to corrosion experiences with water. Many such references give no analysis of the water in question, although the analysis is perhaps the most important factor involved in the particular corrosion problem being discussed. Similar omissions of temperature, pressure and flow rates, all controlling factors, are frequently encountered in the literature.

CHEMICAL ENGINEER

REPRINTS

To the Editor of Chem. & Met.:

Sir:—May we congratulate you upon the "Materials of Construction" report in your September issue, and ask how we can arrange to get about six reprints.

We would very much like to have it for use of our engineers and management.

B. T. BONNOT

President
The Bonnot Co.
Canton, Ohio

To the Editor of Chem. & Met.:

Sir:—We would appreciate your sending us two additional copies of the September, 1944, issue of your magazine, or if available separately, pages 93 to 136 entitled "Materials of Construction for Chemical Engineering Equipment."

We are called on to supply spray nozzles to handle all kinds of chemicals and these charts and data will be of great assistance in making recommendations.

E. B. FRAME

Monarch Manufacturing Works, Inc.
Philadelphia 34, Pa.

To the Editor of Chem. & Met.:

Sir:—I have examined your September issue and found the section on "Corrosion" to be very interesting and informative. I have three men working with me who do not have access to *Chem. & Met.*, and who are interested in the section. During examination of the issue I could find no mention of the printing of reprints of this section. Is it possible to obtain the same?

H. H. MARTY

B. F. Goodrich Co.
Louisville, Ky.

(Reprints are available. As long as the supply lasts, they are being sold at 50 cents each, with a 20 percent discount for quantities of ten or more.—Editor.)

R = RECOMMENDED

To the Editor of Chem. & Met.:

Sir:—Your tabulation of corrosion resistance of metals and alloys (*Chem. & Met.*, Sept. 1944, pp. 107-130) uses the undefined symbol "R." Does this stand for resistant, recommended, reject, or what?

CHEMICAL ENGINEER

(R = Recom. = Recommended.—Editor.)

Yours For the Asking—

The 1944 Porter Catalog

Combining three famous names . . . A comprehensive presentation of America's most complete line of Process Equipment for the Food, Chemical, and Oil Refining Industries. If you have not yet received your copy, write for it today—keep it on your desk as a guide to the buying of pumps, mixers, pressure vessels, dryers, heat exchangers, etc.

H. K. PORTER COMPANY, Inc.
AND SUBSIDIARIES
Pittsburgh 22, Pennsylvania

Factories at Pittsburgh, Pa. • Blairsville, Pa. • McKeesport, Pa.
Mt. Vernon, Ill. • Newark, N. J. • New Brunswick, N. J.

CHEMICAL ENGINEERING NEWS

CHEMICAL INDUSTRY ACTIVE IN WAR LOAN DRIVE

UNDER THE leadership of W. C. Keeley, vice president of the Air Reduction Co., Inc., the chemical industry in the New York area has been mobilized for the Sixth War Loan Drive. Howard R. Salisbury, sales manager of Air Reduction has been delegated to direct the plans and activities of the committee which is assisting Mr. Keeley in the attempt to reach the industry quota of $60,000,000.

Members of the committee are: A. M. Kahn, president, Consolidated Products Co.; Charles M. Richter, president, Pharma Chemical Corp.; Geo. F. Handel, president, Cincinnati Chemical Works, Inc.; C. A. Mace, secretary, Synthetic Organic Chemical Mfrs' Ass'n.; W. R. Reich, Jr., vice president, Carbide & Carbon Chemicals Corp.; Sanford L. Hermann, vice president, Apex Chemical Co.; Ransdell Matthews, vice president, Merchants Chemical Co., Inc.; W. C. Shallcross, Solvay Sales Corp.; Milton F. Martin, assistant general sales manager, U. S. Industrial Chemicals, Inc.; S. Askin, manager industrial relations, Heyden Chemical Co.; George Skakel, Great Lakes Carbon Corp.; and Clifford G. Dixon, vice president, William S. Gray & Co.

TRUST CREATED TO HANDLE UNIVERSAL OIL AFFAIRS

CREATION of a trust under which the Guaranty Trust Co. of New York is trustee of securities of the Universal Oil Products Co. of Chicago for the benefit of the American Chemical Society was announced last month by the late Dr. Thomas Midgley, Jr., president of the Society. The trust, known as The Petroleum Research Fund, was set up to administer the gift made by a group of oil companies owning securities in Universal.

The management and operation of the Universal Oil Products Co. will be under the direction of a board of directors to be appointed by the Guaranty Trust Co. of New York as trustee. Dr. Midgley said the Society will have no obligation insofar as the management of Universal Oil Products Co. is concerned but will have absolute discretion in the matter of selecting the research projects. The Society can withdraw at any time it feels that it should not act further and it can then disclaim any interest in the trust.

UNION CARBIDE ESTABLISHES SEPARATE PLASTICS GROUP

DUE to the importance and diversification of the various developments in the field of plastics among various units of Union Carbide and Carbon Corp., it has been found advisable to correlate these activities. Hence, the corporation has announced the formation of a new Plastics Group within the organization which brings together many activities that are related either to the manufacture, compounding or sale of synthetic resins and plastic products. This step was taken to coordinate the technical knowledge, sales engineering, research, production and distribution of such products. Bakelite Corp. will carry on the integrated sales activities of the new group.

PLASTIC ASSOCIATIONS MERGE INTERESTS

ANNOUNCEMENT is made that the Resin Adhesive Manufacturers Association and the Plastics Materials Manufacturers Association have completed a merger whereby those members who are principally interested in adhesives will operate as a Resin Adhesive Division of the Plastics Material Manufacturers Association in handling technical and other matters relating solely to resing adhesives. Plans are being perfected by the association to establish an extensive research program which will be carried out at Massachusetts Institute of Technology.

ELECTROCHEMISTS HOLD EIGHTY-SIXTH MEETING

THE Electrochemical Society held its 86th meeting at Buffalo, N. Y., October 12-14 with a record attendance of 500. President S. D. Kirkpatrick opened the meeting Thursday afternoon and introduced R. L. Murray, vice president of Hooker Electrochemical Co., who presided at the session on production of caustic and chlorine.

The session on induction heating was under the charge of James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala. Dr. George W. Vinal, National Bureau of Standards, Washington, D. C., presided at the meeting dealing with new developments in dry cells. Dr. F. A. Lowenheim, Metal and Thermit Co., Rahway, N. J., was in charge of the symposium on electrodeposition. The final meeting was in three round table discussions. Dr. C. L. Mantell was in charge of the teaching of electrochemical engineering. J. L. Osborne led the discussion on bright plating, and R. E. Cushing presided over the meeting on the causes of color in electrolytic caustic soda.

The outstanding feature of this Electrochemical Society convention was the dinner on Friday evening at which Dr. William Blum, National Bureau of Standards, was presented the Edward Goodrich Acheson Medal and $1,000 prize. President Kirkpatrick presided and made the presentation following addresses about the scientific accomplishments and personal side of the medalist by Dr. Hiram S. Lukens and Thomas Slattery. Dr. Blum, after accepting the Acheson award, spoke on the human side of electroplating.

On Thursday evening C. C. Furnas, director of research, Curtiss-Wright Corp., Buffalo, N. Y., addressed the dinner meeting on the developments in the airplane industry.

The Saturday luncheon group was addressed by Ralph M. Hunter, Dow Chemical Co., on the electrochemistry of magnesium. Hunter's paper was of unusual interest as he disclosed for the first time much information about the production of this metal at the company's plant.

The board of directors of the society held a meeting on the opening day of the convention. President Kirkpatrick pre-

Dr. William Blum (right) receives Acheson Medal from President S. D. Kirkpatrick

sided. He announced appointment of a committee to consider and report on future activities of the society. Dr. Lukens was asked to head this committee. Others appointed were: Ralph M. Hunter, Raymond R. Ridgway, Oliver W. Storey, Sherlock Swann, Jr., and William Winship. The first meeting of this committee is scheduled for November 20 at St. Louis. President Kirkpatrick reported that Dr. J. F. Gall had accepted the chairmanship of the Division of Theoretical Electrochemistry.

The next meeting of the society will be at Atlantic City next April with the Philadelphia section in charge.

ASTM GETS DISTINGUISHED SERVICE AWARD

At a special meeting of the American Society for Testing Materials in Philadelphia, October 12, Major General G. M. Barnes, chief, Technical Division, Army Ordnance Department, presented to the Society the Ordnance Distinguished Service Award, this having been authorized some weeks earlier. President P. H. Bates, National Bureau of Standards, received the award for the members; preceding the special meeting there was an informal dinner with local ordnance officials and representatives from Washington present with officers of the Society and local members.

In tendering the award, which was made, "In recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of Ordnance materiel," General Barnes stressed the great uniformity, reliability and quality which ordnance materiel must have, the quality being insured by proper and adequate specifications.

WESTINGHOUSE FORMS NEW EDUCATIONAL DEPARTMENT

Formation of a new Educational Department, coordinating all of the company's relations with schools, colleges and universities, has been announced by the Westinghouse Electric and Mfg. Co. The new department, located in Pittsburgh will have three main divisions. The first of these, School Service, provides teaching aids and science information to all schools and educational institutions up to and through the high school level. Charles W. MacLean, present manager of the division, will continue in that position.

A second division, University Relations, maintains close contact with colleges and universities, administers the company's numerous scholarships and fellowships and supervises the recruiting of graduate student employes. Howard C. Madsen has been named manager of this division.

The training of all graduate students for engineering, manufacturing, sales and other departments of the company is supervised by the third division, Student Training. O. D. Montgomery has been appointed manager of this division.

INDUSTRIAL RESEARCH MEN MEET AT ATLANTIC CITY

The Industrial Research Institute held its fall meeting last month at the Claridge Hotel, Atlantic City, N. J. Ninety research directors, vice presidents, and other industrial executives were in attendance with current and postwar problems of research management as the principal topics under discussion. One of the highlights was a roundtable conference concerned with the techniques that may be effective in stimulating industrial research workers to give of their best abilities under present conditions of personnel shortage and salary restrictions. This session was organized by Warner Eustis, The Kendall Co., Boston. Discussions were led by Emil Ott, director of research, Hercules Powder Co., Wilmington; J. H. Schaefer, vice president, Ethyl Corp., New York; N. A. Shepard, chemical director, American Cyanamid Co., New York; and L. A. Watt, director, development department, organic chemicals division, Monsanto Chemical Co., St. Louis.

CONVENTION CALENDAR

National Exposition of Power and Mechanical Engineering, Madison Square Garden, New York, N. Y., Nov. 27-Dec. 2.

American Society for Testing Materials and American Institute of Mining and Metallurgical Engineers, symposium on stress corrosion cracking, Hotel Benjamin Franklin, Philadelphia, Pa., Nov. 29-Dec. 1.

American Society of Refrigerating Engineers, annual meeting, Pennsylvania Hotel, New York, N. Y., Dec. 10-13.

American Institute of Mining and Metallurgical Engineers, annual meeting, Pennsylvania Hotel, New York, N. Y., Feb. 18-22, 1945.

Technical Association Pulp and Paper Institute, annual meeting, Commodore Hotel, New York, N. Y., Feb. 19-22, 1945.

American Institute of Chemical Engineers, regional meeting, Houston, Texas, Apr. 1-4, 1945.

The Electrochemical Society, Inc., annual meeting, Hotel Claridge, Atlantic City, N. J., Apr. 12-14, 1945.

CONSULTING CHEMISTS HOLD ANNUAL MEETING

THE annual meeting of the Association of Consulting Chemists and Chemical Engineers, Inc., was held on Oct. 24 at the Hotel Shelton, New York. The meeting took the form of a symposium on liquid fuels with Benjamin T. Brooks, Walter M. Fuchs, and Henry M. Shields as the main speakers. The outgoing president, H. P. Trevithick, announced that the name "A Clearing House for Consultants" in conjunction with that of the Association had been granted a trade mark as of Oct. 31.

At the business session officers for the ensuing year were elected as follows: Albert Parsons Sachs, New York, president; Henry M. Shields, Bull and Roberts, New York, vice president; Claude F. Davis, Schwarz Laboratories, Inc., New York, secretary; and Sam Tour, Sam Tour & Co., Inc., New York, treasurer. New directors elected for three-year terms were Ralph L. Evans, Ralph L. Evans Associates, New York; Benno Lowy, Pacific Chemical Laboratories, San Francisco; and Abraham Taub, assistant professor, College of Pharmacy, Columbia University.

NEW LOCAL SECTION OF ACS FORMED IN WABASH VALLEY

ORGANIZATION of a new Local Section of the American Chemical Society composed of chemists of the Wabash Valley has been announced. H. V. Fairbanks of Rose Polytechnic Institute, Terre Haute, is chairman of the new unit, which has been officially chartered as the Wabash Valley Section, with headquarters in Terre Haute. Carl W. Frerichs, works manager of Crescent Products Co., Terre Haute, is vice chairman, and Esther A. Engle of Commercial Solvents Corp, Terre Haute, is secretary. The treasurer is Dr. Richard S. Egly of Commercial Solvents Corp.

NEW TIRE PLANT IN COLOMBIA NEARS COMPLETION

THE NEW tire and tube plant being built near Bogota, capital of Colombia, South America, by the Industria Colombiana de Llantas, S. A., is being rapidly completed and production should start about January 1, according to an announcement by Stanley W. Caywood, general manager of the International Division of the B. F. Goodrich Co. which is associated in the project, furnishing technical and engineering counsel as well as part of the capital. J. M. Robbins has been named technical representative of Goodrich and he will make his headquarters in Bogota.

Capacity of the plant will be around 100,000 tires and tubes annually, in addition to tire repair materials and automotive accessories. This is about equal to the prewar requirements of the country. The plant will process between 700 and 800 tons of rubber a year which will be supplied by domestic production. Colombia also grows cotton which will be used in tire manufacture.

The company, of which Antonio Puerto is president, was organized by the Instituto de Fomento Industrial of which Gabriel

Durana Comacho is managing director. Through this agency the Colombian government provides the original Colombia capital and then eventually disposes of these interests to its nationals.

OUTPUT OF PHOTOGRAPHIC FILM INCREASED

To MEET military and essential civilian requirements for photographic film, the industry has increased its output by about 45 percent as compared with the 1941 total. The eight producing companies reached an all-time high in the second quarter of this year with an output of almost 160,000,000 sq.ft. In the third quarter, production dropped to about 136,000,000 sq.ft. because of a drop in manpower and because some equipment was temporarily out of use because of the necessity of cleaning and repairs.

Between 65 and 70 percent of production is being allotted for civilian purposes but as more than one-half of this ultimately finds its way to the armed forces, only about 15 percent of the available supply is used by professional and amateur photographers for other than war purposes although this represents more than 50 percent of the amount so available before the war.

More than 50 chemicals are used in the manufacture of film and shortages of materials have not yet curtailed production to any great extent even though many of these chemicals are important in the manufacture of smokeless powder.

N. Y. U. CHEMISTRY ALUMNI FORM ASSOCIATION

GRADUATES in chemistry and chemical engineering of New York University have organized a chemistry alumni association to promote the welfare of the alumni and the University. Dr. Maximilian Toch, head of Standard Varnish Co. and of Toch Bros., is honorary president. Bruce Silver, New Jersey Zinc Co., is president; Kenneth L. Saunders, American Cyanamid Co., vice president. Other officers include Dr. John N. Petras, U. S. Rubber Co., treasurer; T. W. Davis, New York University, secretary; and four members of the executive committee: Morris Ziff, College of Physicians and Surgeons; Aubison Burtsell, Queens College; Kenneth L. Russell, Colgate-Palmolive Peet Co.; and Jonas Kamlet, Kamlet Laboratories.

TEXTILE INSTITUTE OFFERS RESEARCH FELLOWSHIPS

THE Textile Research Institute's program of graduate training went into effect at Princeton, N. J., on Nov. 1. Through this program the Institute will offer a number of research fellowships and the fellows will have an opportunity to work towards their doctors degree at Princeton University and also to do research work in the laboratories of the Textile Research Institute. Those accepted as fellows will receive $700 a year and the Institute will also pay the graduate tuition fees. Prospective fellows may send inquiries to Dr. Henry Eyring at Princeton.

DIAMOND ALKALI PURCHASES EMERYVILLE CHEMICAL CO.

THE Diamond Alkali Co., Pittsburgh, has purchased the Emeryville Chemical Co. which has its offices in San Francisco and its plant at Emeryville, Calif. Manufacture of silicate of soda, sodium metasilicate, and silicate compounds will be continued at Emeryville, and Stanley Pedder and Charles Eckland will continue in their present capacities as president and vice president of the company. No changes in personnel are contemplated except that Howard R. Bauer has been transferred from the Diamond Alkali organization to San Francisco where he will serve as general manager of the purchased company.

BARRETT WILL BUILD PLANT AT IRONTON

ANNOUNCEMENT has been made by the Barrett Division, Allied Chemical & Dye Corp., that it will soon build a modern tar distillation plant at Ironton, Ohio. Ironton, which is 140 miles southeast of Cincinnati was selected as the site because of the availability of required raw materials and because of its central location and excellent transportation facilities. The plant which will be devoted primarily to the distillation of coal-tar for recovery of a varied line of chemicals will cover a large area and will be adjacent to the Semet-Solvay plant.

STERLING DRUG TO ACQUIRE HILTON-DAVIS CO.

PLANS have been made for the reorganization of the Hilton-Davis Chemical Co., Cincinnati, through the transfer of its assets, business and good will to Sterling Drug, Inc. The transaction involves an exchange of stock on the basis of 3¼ shares of Hilton-Davis for one share of Sterling. Shortly after the first of next year, the plans call for the dissolution of the Cincinnati company and its operation thereafter as a division of Sterling Drug, Inc.

BOSTON MEETING TO DISCUSS UTILIZATION OF WOOD

THE Northeastern Wood Utilization Council will hold its next regular quarterly meeting on December 14 at the Hotel Manger, Boston. The main topic for discussion will be the use of forest products for building and housing. Besides lumber and improved woods, such as impregnated and compregnated wood, the production and use of plywood and laminated wood from low-grade species will be taken up. There will be reports on the use of pulp and plastics for postwar housing and on the competitive position of forest products with respect to metals, ceramics, and glass.

DuPONT WILL ESTABLISH BRANCH AT AKRON

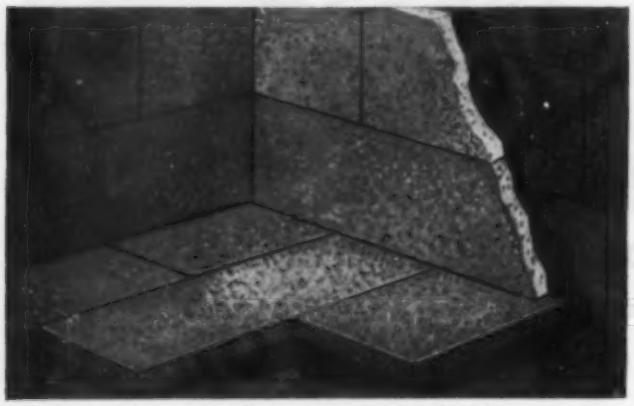
A TWO-STORY building at 311 South High St., Akron, Ohio, has been purchased by E. I. du Pont de Nemours & Co., Inc. It will be remodeled for the installation of office and modern testing and service equipment. It will house the Rubber Chemicals Division of the company.

New Cold Room Construction Keeps Out Heat and Moisture

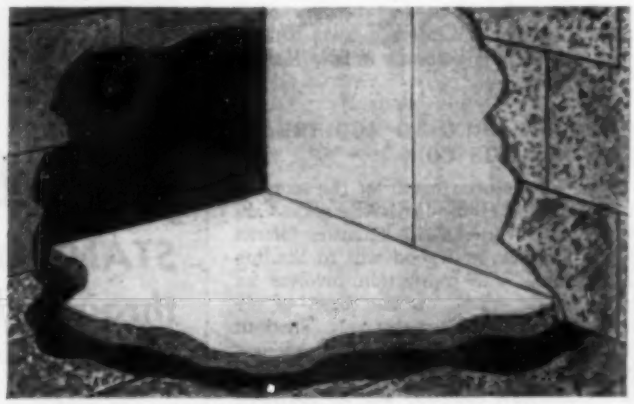
Armstrong's New Low-Temperature Insulation Method Provides Permanent Efficiency

1. Priming Coat of Armstrong's Asphaltic Paint seals the walls of the cold room before insulation is erected.

2. Outer Shell of Foamglas* provides insulation plus a positive, permanent, moisture and vapor barrier.



3. Inner Layers of Armstrong's Corkboard keep heat out of room with maximum insulating efficiency.



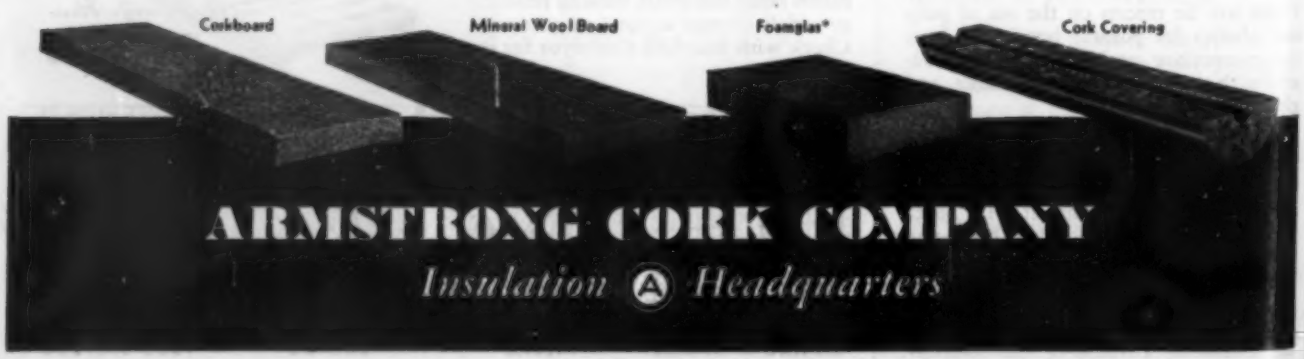
4. Finish either in Armstrong's Asphalt Plastic or portland cement plaster, according to specifications.

ARMSTRONG'S new low-temperature insulation construction combines corkboard and Foamglas to take full advantage of the best properties of both materials.

Armstrong's Corkboard, a cellular insulation, has exceptionally low thermal conductivity and provides high operating efficiency. Foamglas is glass in cellular form. It's an insulation that's absolutely moistureproof, vaporproof, and fireproof—making a lasting seal. Together, these materials assure permanently high insulating efficiency.

FOR COMPLETE INFORMATION about this construction—including engineering drawings and erection specifications—write to Armstrong Cork Co., Building Materials Div., 3311 Concord St., Lancaster, Pa.

* Reg. U. S. Pat. Off. Product Mfg. by Pittsburgh Corning Corp.



ARMSTRONG CORK COMPANY

Insulation Headquarters

NEWS FROM ABROAD

BRITISH EXPORTERS OF COAL-TAR PRODUCTS LOOK FOR LARGER POSTWAR MARKETS IN UNITED STATES

Special Correspondence

TO SAY what British exporters expect from the American chemical market after the war is not easy. It is indeed difficult to say anything about their export plans in general, since so much must depend on the attitude of the authorities. Is export control going to stay? Is it to be reduced gradually? If so, will the authorities give exports priority to restore a satisfactory balance of payments or will they give the home market priority? Will they favor a selective export policy, laying stress on Dominion and Colonial markets or encourage commerce with continental Europe to speed up reconstruction and rehabilitation in the countries devastated by the Nazis? These and other questions concern only matters of policy, but there are many administrative and practical considerations, too, which must greatly affect British chemical exporters after the war and have as yet received very little attention.

Before the war the United States provided an important outlet for certain surplus products of British chemical industry, but viewing the trade as a whole, it is surprising to note how small was the percentage of British export chemicals placed in the American market. The United States did not absorb more than 5 percent of Britain's chemical exports in any of the last years before the war, and even this figure was reached only on account of a few products favored by special conditions on both sides of the Atlantic. Exports to the United States were of some importance in the case of barium compounds, cresylic acid, naphthalene, heavy coal-tar oils, and at times for glycerine and a few other articles. Otherwise British sales in the big American market were confined to such occasional items as are exchanged between leading commercial nations in the normal course of trade almost as a matter of course. The total of British chemical exports to the United States—£1,250,000 in 1937—is exceedingly small, whether compared with other chemical exports from Britain or the potentialities of the American market or indeed chemical commerce in the opposite direction. Moreover, more than half this trade concerned a few coal-tar derivatives.

There are, of course, obvious limits to an expansion of British chemical exports to the United States. The British Isles lack many of the specifically chemical raw materials which enter chemical production,

and while chemical manufacturers can draw upon a very important source of raw materials in the form of byproducts from metallurgical and other industries, these are quantitatively hardly important enough to permit exports. Moreover, British home industries are large buyers of most chemical manufactures, a fact which sets limits to exports of articles which are sold cheaply only because outlets in the domestic market are lacking. There is only one chemical raw material which is available in really abundant quantities in Great Britain, namely coal; and coal derivatives play a very important part in exports to the United States, largely because the home market is not sufficiently large to absorb the whole output while the United States require imports to augment home production.

There is good reason to believe that after the war Great Britain will have considerably larger tonnages of these derivatives available for export. Home consumption of coal is undergoing a process of transformation; use of coal as fuel is now regarded as wasteful and uneconomical, extraction of valuable byproducts is considered desirable, not only because of the growing importance of these, but also because it makes the residual coal a better fuel. Concentration of the gas and coke-oven industry in larger units, plans for regional power and gas distribution, the need for an overhaul of much of the at present somewhat out-of-date plant capacity, and the research now being carried out into modern processes of coal treatment and utilization—all these factors point in the direction of increased byproduct output, while consumption has not risen correspondingly. Since transport is one of the major economic problems in wartime, there has been a tendency to use some byproducts as substitutes, even where their specific qualities were not turned to the best advantage, but this is a strictly temporary development which will come to an end as soon as imported fuel oil, etc., are in ample supply.

SURPLUS OF BYPRODUCTS

When this happens, the British coal processing industry will be faced with a constant surplus of certain byproducts, especially the heavier derivatives, and much thought has, therefore, been given to their utilization for new purposes. Some progress has been made and waits for the end of the war to find practical application. There is no doubt that the building industry will absorb large quantities of these products, but since the United States has been the biggest single export market for coal-tar products in the past, providing a seemingly unlimited outlet for Britain's surplus, great hopes are based on an expansion of this trade after the war, including its development by offers of a wider range of more highly specialized items.

As far as export prospects of other chemical products are concerned, British chemical manufacturers are not very hopeful. Obviously the demand for certain articles, like earth colors, is bound to continue in normal circumstances, and there may be a possibility of expanding the business in colonial products, such as pyrethrum from Tanganjika, vegetable oils from West Africa, and other tropical plants

from East Africa. Wartime research progress in these territories will certainly permit of peacetime application, but it is unlikely that American consumers will buy finished products, since the purchase of the raw material as produced in the colonial territories will presumably be more advantageous for transport and other reasons. It is thought that certain clays obtained in the British Isles will offer good export prospects, and the supporters of a big Scottish seaweed processing industry think that it could provide export materials. These and other possibilities, however, are unlikely to affect the chemical trade as a whole to any notable extent as they may not reach a large tonnage.

SPECIAL PRODUCTS

It is more likely that British chemical manufacturers will supply the United States market with those specialized and branded products in which they have great experience through branch factories in the United States. This, after all, corresponds to the policy pursued by British and other European producers before the war, and while it was in part due to import tariffs and other obstacles to free trade, this system has generally proved satisfactory. It is also thought that there will be more cooperation between chemical manufacturers in the two countries, with the result that experience and knowledge can be pooled and factories of cooperating firms can turn out each others' products for distribution in their home market.

Whether this is done under long-term agreements as by leading chemical combines at present or under special licensing arrangements or by any other means is immaterial. The important point is that with research and development taking up more and more time and involving increasing expense, early utilization of new developments in all markets becomes essential. A British producer who has developed a new process simply cannot afford to wait until his products has been accepted in the home market and then expand output to meet export demands. Wartime experience has shown British manufacturers the special ability of American firms in turning new processes developed up to the point where they can be commercially utilized to large-scale production. The speed with which the output of critical materials and new drugs, for instance, has been increased to meet wartime needs in the United States has aroused unreserved admiration.

On the other hand, British chemical manufacturers have discovered that their experience in working for a comparatively small home market is an advantage in judging and assessing opportunities and requirements in other smaller markets. Their valuable connections with the Dominions, on the one hand, and the huge demand which is expected to arise in continental Europe soon after the war, on the other, should provide them with great opportunities, which may be advantageously covered in cooperation with United States firms whose practical knowledge of these markets is necessarily limited. It is in what may be termed the more "modern" chemical products that there are especially great opportunities waiting for the chemical exporter in some of these markets.

CHILEAN FACTORIES TURN OUT MORE MATCHES

PRODUCTION of matches in Chile this year is expected to reach a total of 155,000 cartons as compared with 133,194 cartons in 1943. Domestic consumption for the fiscal year beginning July 1, 1944, is estimated at about 133,000 cartons, hence there will be an exportable surplus which probably will go to neighboring countries. Compañia Chilena de Fosforos has two match factories, one at Talca and the other at Rengo, both in central Chile which has forests of poplar and aspen. A new factory, Fabrica de Fosforos de Carton, Santiago, has been established to manufacture paper matches. It also will produce cardboard and pyrotechnics.

FINLAND OFFERS LIMITED MARKET FOR CHEMICALS

FUTURE development of the chemical industry in Finland faces the difficulty of a limited potential market and consequent high production costs. Before the war, only the cellulose industry demanded chlorine in quantities sufficiently large to justify the establishment of chlorine plants. When war conditions prevented utilization of the chlorine, the production of chlorinated acetylene was undertaken. It has been recommended that uses for sulphite liquor be investigated and that greater consideration be given to the establishment of research laboratories and to the training of chemists.

POTASSIUM CHLORATE SCARCE IN MEXICO

THERE is no production of potassium chlorate in Mexico as plans of Productos Quimicos Mexicanos S. A. to establish a chlorate plant had to be postponed until after the war. The chemical is used in Mexico for match manufacture and for various other industrial purposes. Normal annual consumption by the match industry totals between 360 and 400 metric tons while for other purposes it averages between 250 to 350 tons. Under war conditions, its use has been largely restricted to the match industry.

PERU IMPORTS CITRIC AND TARTARIC ACIDS

WHILE occasional shipments of tartaric acid from Spain have reached Peru, that country has obtained most of its supply since the war from the Argentine. It has been used to supplement the reduced supplies of citric acid. The United States is now the principal supplier of citric acid. Before the war, Peru filled the greater part of its requirements for these acids by imports from Italy, Germany, and Spain.

ARGENTINA GETS BICHROMATES FROM SOUTH AFRICA

FOR MANY months there has been a shortage of bichromates in the Argentine. It is now reported that heavy shipments have been received from South Africa and Argentine tanneries are now operating on a more normal basis.

SPAIN HAD LARGE OLIVE CROP THIS YEAR

THE VERY large olive crop in Spain this year has permitted greatly increased production of olive oil, and consequently much wider distribution of this commodity to Spanish provinces and possessions. Shipments of edible olive oil during the first half of the current year totaled 41,456,955 kg., compared with 21,359,723 kg. in the corresponding period of 1943. Shipments of inedible olive oil for the first six months amounted to 337,232 kg., more than a 50 percent decrease from the 857,980 kg. shipped in the corresponding period of 1943.

INDUSTRIAL ALCOHOL PLANT FOR SOUTHERN RHODESIA

A COMMISSION has been appointed in Southern Rhodesia to assist in the establishment and management of an industrial alcohol plant. Efforts will be made to utilize various domestic raw materials, such as molasses, sweet potatoes and corn. Although £90,000 have been appropriated by the parliament for the plant, so far only a small amount has been expended, partly because of the difficulty of obtaining machinery. The commission may possibly develop later into a public utility company.

PORTUGAL PLANS FOR NEW CHEMICAL DEVELOPMENT

MANUFACTURE of several chemical materials for agricultural purposes will be undertaken in Portugal as part of a program for industrial development. Plans call for the production of ammonium sulphate, copper sulphate, and artificial fertilizers, all of which would represent new industries.

SWEDISH COMPANY TO MAKE SYNTHETIC METHANOL

A SYNTHETIC methanol plant will be erected at its Stockvik works by Stockholm Superfosfat Fabriks A/B. The process to be employed will produce methanol by high-pressure synthesis from synthetic gas obtained by converting wood or coke to gas with the use of oxygen and steam. The new plant will have an initial capacity of 2,000 to 3,000 metric tons annually. Construction is expected to be completed within a year.

NEW RAYON TEXTILE PLANT FOR AUSTRALIA

ACCORDING to press reports, the first combined rayon weaving, dyeing and finishing production unit to be established in Australia has been planned for Rutherford, New South Wales, a small inland town about 24 miles northwest of Newcastle. It is to be housed in a government-owned building and the machinery will be of United States origin and technical assistance will be provided by a United States rayon weaving company. Before the war, Australia imported about 60,000,000 yd. of rayon fabrics annually, mainly from Japan.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

The recent invitation for "guest columnists" resulted in a gratifying response. Dale S. ("Dave") Davis' contribution which appears below is proof that no one industry has a monopoly on anecdotes. Customers appreciate an occasional change of fare, therefore it is delightful to read of the fine qualities of Dave's comrades in the pulp and paper field and of the short cuts by which they made a dollar accomplish the thing for which the bungler requires ten. Dave is welcomed to the column and it is hoped that more fellows will kick-in with character-revealing episodes.—Dan Gutleben

PAPER MILLS in New England and in the Seaboard and Lake States are located in communities of a wide range in size: teeming cities such as Philadelphia; quiet, pleasant places like Franklin, Ohio; busy, vital, little cities such as Glens Falls, N. Y., and Chillicothe (Indian for "A place where men live"), Ohio; college towns like Appleton, Wisconsin; villages such as Millinocket, Maine, which nestles in the shadow of snow-capped Mt. Katahdin; and mere whistling posts fated to become, alternately, boom and ghost towns as economic changes affect the industry.

Such a place is Piercefield, N. Y., huddled close to the Racquette River and hidden away in the Adirondacks half a day by automobile from a city of any size. In 1927 The International Paper Co. owned and operated everything in town except the United States Post Office and the Catholic Church, and all Piercefield's 750 people lived in company houses supplied at very low rentals. Quite satisfactory quarters could be found for eight to ten dollars a month, with free electricity, while one could pay twelve to fifteen dollars for larger houses if he really wanted to put on the dog.

There was no theater, of course, but there were movies in the Community Building which also housed an excellent company restaurant, library, and dance hall. Some, who felt the need for further amusement and sustenance, used to shoot deer from the windows of the beater-room. The Piercefield mill is idle now but there was a time when great plumes of white vapor towered high in the bracing Adirondack air, when the clean, fresh fragrance of cymene greeted the visitor, and when they had to elect members of the village council all from the same shift so they could hold meetings.

ALADDIN'S WONDERFUL LAMP has performed some neat tricks in its time, and so has thermodynamics; but Harvey N's experiment in child psychology proved for all time that they don't make the best of bedfellows. Harvey, resident engineer for one of the New England bond mills, had been the town's most eligible bachelor for years and years. Though active in civic social affairs and frequently the escort of one or another of the local charmers, Harvey never specialized to the extent where his freedom was in any great danger. By the time he had passed his fortieth milestone no one ever expected him to marry, and it was a surprise to all when he did just that.

Harvey's bride was the only daughter of the new mill manager, a young widow with a little boy of seven. The town shook its head sadly—a newcomer! What did an old bachelor like Harvey know about children?

What Harvey didn't know he proceeded to find out, tackling the problem as if it were a new Trimbey system or a difficult matter of stock proportioning. Harvey read child psychology, Ellis, and the behaviorists. Most practical of all he made fast friends with the little fellow and studied his wife's methods. Gradually he evolved some ideas of his own, tested them out frequently, and reported progress to us from time to time during the lunch hour at the mill.

It began to look as though Harvey were going to carry the day with flying colors, for even the village wags had done an about-face. Jeers had turned to cheers. For the sake of Harvey's reputation, then, we were glad that no one accompanied us on a certain well-remembered visit.

Passing the house early one evening, we stopped in to see Harvey in action. "He's upstairs reading to Gerald," his wife said. "Go on up and listen in. It's 'Arabian Nights,' I think."

Pausing at the open door to the boy's room, we were astonished to hear, ". . . and, noting Aladdin's surprise, the Genie explained that when a system takes part in any process whatsoever, the amount of the energy resident in that system changes only by the net amount of energy in any form which may be absorbed or given off by the system during the process. Every system left to itself will, on the average, change toward a condition of maximum probability. For any substance in a single pure quantum state, the entropy at the absolute zero of temperature may be taken as zero."

"What on earth?" we queried a few minutes later, when Harvey's wife had taken over and we were on the way downstairs.

"It's perfectly simple," Harvey said. "And it bears out my pet theory, too. You see, at this time of day when a child is tired he likes to be read to, but it's the soothing sound of the voice that appeals to him and not the context. You saw just now how I switched over from 'Arabian Nights' to the First, Second and Third Laws. Gerald never noticed the difference and he was entirely happy with the whole thing. I've been doing that on alternate evenings for a week. We take turns reading to him, you see."

The boy's mother came down a little later and said, "Harvey, Gerald asked a curious question just now. He wants to know why 'Arabian Nights' is always so much more exciting when *I* read it to him!"

"WEAK AND SINFUL," confessed Uncle Charlie Murdock. "I'm just a weak and sinful old man." Actually Uncle Charlie was a gentle old soul of some 70 summers who was spending his declining years in sweeping out the laboratories and doing light janitorial work. There really wasn't enough for him to do and from two until four, when he went off duty, he usually worried a little pile of dust up and down a long corridor, just to keep busy. It was then that he'd lean on his broom, shake his head sadly and say, "Mister, I'm a weak and a sinful man."

Uncle Charlie had developed a great liking for the square dance, and Saturday nights during the long Adirondack winter found him clapping his hands and stomping with the best of them. A more innocent and wholesome pastime could hardly be imagined but Uncle Charlie really felt it was wrong for him to be so worldly minded. He tried repeatedly to give up square dancing but he just couldn't keep his good resolutions. As he said so often, he was a weak and a sinful man.

No matter how late he danced Saturday night Uncle Charlie was always at church Sunday morning. That was the winter that Dr. Judkins preached on only one topic: "The Consciousness of Ceaseless Creative Activity." Abstruse at best, the sermons meant very little to any of us and must have bored Uncle Charlie mightily. Perhaps he sat through them as a sort of punishment for his weak and sinful life.

One Saturday morning he told us about being at a church supper the night before and about the singing which followed.

"There was one song that was real good," he said. "I don't rightly know the name of it, but it sounded like 'We Can Sing, Full Though We Be'. I keep thinking about it."

That evening Uncle Charlie took in his last square dance. His stout old heart failed him on the dance floor in the midst

of a Sir Roger de Coverly and we buried him on Tuesday. The service was simple, Dr. Judkins forgot about 'Ceaseless Creative Activity' for once and quite redeemed himself with his choice of the music. The hymn was Uncle Charlie's theme song and his favorite of the night before, "Weak and Sinful Though We Be."

UNCLE CHARLIE'S SUCCESSOR was a fat, genial German, Phil Kuss, who had been helping the beatermen and who had his eye on the janitor's job for quite a while. About this time Phil had seen fit to furnish a sulphite beater with several bales of southern kraft and we had to bleed the contents into the sulphite chest gradually for a week. Maybe that wasn't why they transferred Phil to the laboratories but, as he said, it helped.

Phil saw his new job as an excellent chance to further one of his side lines and he was soon putting the bee on the boys to buy his chewing gum and candy bars. The gum was all right and the candy bars weren't really so very stale, but no one ever bought a second bottle of his auto polish. Packaged in old pop bottles and labeled neatly in angular German script, it made a pretty fair appearance but some said it was a mixture of horse liniment and crank case oil drained from Phil's brass-trimmed Model T.

Phil was a big talker and greatly enjoyed recounting his experiences. Some of us felt that Phil remembered distinctly a lot of things that had never happened, but, true or not, his tales were always interesting. At that we never had any real reason to doubt his yarns until someone, piecing together his claims of having worked here so many years and there so many years, estimated that starting at seven years of age and allowing no time between jobs Phil would have to be at least 125 years old.

He was a great admirer of Jimmie Walker, then mayor of New York, and had actually met him it seemed. Phil would stop by the office sometimes and say, "Dave, you're wasted here. I'm going to speak to Jimmie Walker about you the next time I see him." Probably Phil forgot all about it; at least Mr. Walker never came through.

Phil kept the place clean and in order but he had his own ideas as to what should be put in the laboratory safe at night and what could be left out. A little before five each afternoon he'd collect whatever paint brushes were lying around and lock them in the safe, ignoring entirely two or three platinum crucibles. When asked about this he said, "The way I figure it, boys, a platinum crucible is a piece of tin but a paint brush is a paint brush."

COLLEGE STUDENTS do the darndest things as we all know—from swallowing goldfish to lifting flowers from graves in the cemetery for resale as fraternity house decorations when a big dance is coming up. Young Gross, at the Institute of Paper Chemistry, had a peculiar system of dating his daily work and bluebooks in a brief course in Nomography given there in the early months of 1932. Feb. 11, 1932, according to Gross, was the third day in the ninth month of the year four

His method of reckoning time was a mystery to everyone. Probably he dated everything from his first encounter with some gorgeous blonde or other.

Every once in a while, though, someone comes up with something bright and original. Irwin Mahler, at Wayne University, was like that. Curious about the paper industry, where he hoped to try out his chemical engineering after graduation, he wrote a lengthy theme on papermaking for his English professor and submitted it to us for comment. Stressing the short interval between tree and finished sheet he closed his opera with a superb tag line —four lines in fact:

See the spruce against the sky?
That is *Harper's* for July.
And the hemlock in the canyon?
That's the *Woman's Home Companion!*

[Editors note:
Spruce and hemlock, don't forget,
Also work for *Chem. & Met.*]

'MODERN PAPERMAKING' was the title of the industrial short subject but it proved to be an old film. We were glad of it, after the first few sequences, for there at his old roll-top desk was Big Bill Murray, genial smile and all, looking just as he did in '26 when we saw him last at International's mill in Livermore Falls, Me. Bill and his two brothers, all genuine old-time papermakers, could claim a total of nearly a century of experience, and it was something of a shock to see him again for Bill has been banging his harp with the angels—or, more likely, banging the angels with his harp—these many years.

He always welcomed young chemical engineers from the company's Bureau of Tests, helped them all he could and was receptive toward technical control methods in general, though he never felt the need for going to all that trouble personally. In the beater-room he'd let us make freeness and pH tests (then new in the industry) to our hearts' content and Bureau men could try out anything which didn't look as though it might interfere with production. Bill was always tolerant of the physical and chemical test methods which we, as glorified whitewater boys might think up, but he always stuck to his own sure-fire methods. Best of them was his invariable habit of judging paper by its taste.

Bill would barge into his office first thing in the morning and call for samples of the night's run. He'd nibble each, clearing his taste once in a while with a puff on a big black cigar, then open his office door and bawl down the corridor, "Ship it out, boys, it's good stuff. Best we ever made!"

Bill's methods would horrify the standards committee of the Technical Association of the Pulp and Paper Industry but they must have been effective. Anyway, he turned out some mighty fine bond at Livermore Falls year after year.

AT TROIS RIVIERES, Quebec, International's Bureau of Testing conducted, during the middle twenties, some very extensive heat and material balances on the vapor removal systems newly installed on its big paper machines. These were always

very enjoyable occasions, in the nature of class reunions, for mechanical and chemical engineers would be pulled off other jobs in the company's mills throughout New England and New York to join those direct from the Bureau.

Trois Rivieres was very French and had three major attractions: a truly beautiful cathedral, a thoroughly up-to-the-minute news mill, and the Chateau de Blois, where the boys always stayed. The Chateau, in turn, had a few attractions of its own: exceptional food, a mineral water spring right in the lobby, and four waitresses who looked exactly like Fifi D'Orsay of movie fame. Of course they spoke only French—such French as none of us had ever encountered in French I, II, or III.

The Chateau served marvelous maple sirup and Bob, our Vermonter, had the idea that he ought to have a doughnut with it just as he would at home. There were difficulties. The youngest, most vivacious Fifi assigned to our table had no idea what "doughnut" might mean, and none of us could come close to the French equivalent. Bob wasn't stumped for long though. Didn't he have a pencil and wasn't there a menu handy? He did and there was. In a moment he'd drawn two concentric circles, one large and the other quite small. Fifi understood at once, laughed, bounced her black curls up and down, tripped gaily off to the kitchen and came back in a few minutes with—a poached egg!

DR. ALLEN ABRAMS, vice president of the Marathon Corp., was toastmaster at the banquet during the 1930 meeting of TAPPI in Erie, Pa., and introduced the late Harrison E. Howe, then editor of *Industrial and Engineering Chemistry*, who gave the address of the evening. Somewhere in his opening remarks Allen, even then known as our silver-haired, silver-tongued orator, delivered himself of this famous line, "Judging from what went on during the boat ride across from Canada last night, many members of the Technical Association of the Pulp and Paper Industry have an idea that T-A-P-P-I stands for—They All Practice Prohibition Intermittently!"

TO STIMULATE BUSINESS a number of years ago, the leading drugstore in Chillicothe had distributed prize purchase-cards to its customers. The cards were handed out liberally; each customer could have as many as he wanted. When making a 25c. purchase the card would be punched, and when a $10 total was reached the clerk would remove a red seal affixed to the upper right hand corner. Under the seal would be found the amount of merchandise to be awarded the customer. The amounts were 25c., 50c., and $1, the latter being relatively scarce.

To a man, the young chemists and chemical engineers in the Mead Corp.'s Technical Service and Development Depts. could see no use in squandering purchases by having them recorded on any but the dollar cards. The cards, of course, would not be validated if the seal had been broken, and it was impossible to remove the seal without damaging it. But these same boys had solved many a knotty prob-

lem in the course of their regular work, and it wasn't long till they had developed a sure-fire method of reading the amount printed under the seal. A little carbon tetrachloride would evaporate without trace, yet while on the paper it would lower the refractive index sufficiently to make the seal transparent. In short order the Central Pharmacy found itself redeeming a surprising number of dollar cards.

AN INSPIRED TYPIST has played hob with the correspondence in more than one business office, and the office of the present writer is no exception. It all started long ago during a pleasant winter in the Fox River Valley, outstanding paper center of Wisconsin. One or two afternoons a week were spent in the library at the newly-founded Institute of Paper Chemistry in Appleton, and at closing time it was often our privilege to give Fraulein Stroschneider, the librarian, a lift across the river in a real antique—a 1919 Franklin which stood 7 ft. 1 in. tall.

Years later we wrote to the "gnadiges Fraulein" about a bibliography, and to establish identity we closed the letter with "We're running around with a new Franklin now. The old one was becoming pretty shabby." Leaving at once for a vacation the letter was left for transcription and signature by the typist. When no answer came after several months we hunted up the carbon copy and found that she had written "Fraulein" for "Franklin", making the final paragraph read, "We're running around with a new Fraulein now. The old one was becoming pretty shabby."

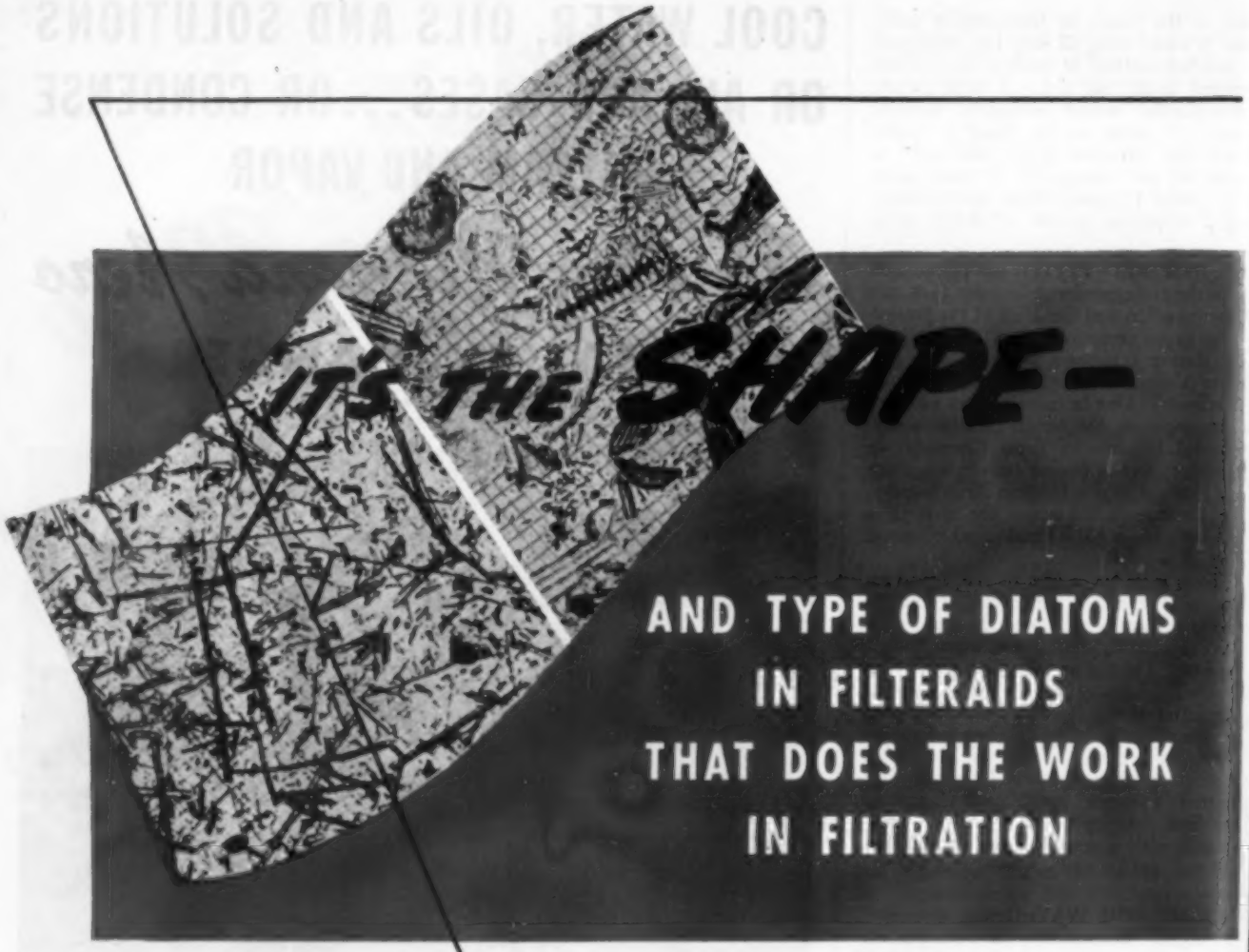
"RIGHT THIS WAY! Getcha silver plating liquid. Fifteen cents takes the bottle!" So ran the cry out in front of the Mead Corp. time office one lunch hour as the crowd pushed closer to watch the vender demonstrate his magic "silver-plating" solution. Every penny and bit of metal he plated meant another sale. "Genuine silver, gentlemen!"

Down in the front ranks was our own Simmie, laboratory assistant in Technical Service, and to Simmie, ever the champion of truth and a rigorous stickler for chemical fact, all this seemed a bit unlikely, even decidedly fishy. Having the courage of his convictions and 15c., Simmie bought a bottle of the liquid magic and disappeared into the laboratory; from which he emerged, almost at once, with an innocent-looking reagent bottle.

"Rally 'round, boys," invited Simmie, putting on a little act of his own. "Here's a bottle of hydrochloric acid from the lab. If there's silver in this stuff, as that bird says, we'll get a nice white cloud when we mix the two. That's the test for silver. Ready?"

The fickle public turned from the vendor to Simmie and watched breathlessly. Simmie added the acid. Nothing happened. There was a murmur from the boys, then a low growl and the crowd turned back to the vender. But this luckless gentleman had remembered an appointment, doubtless with his tailors, and made off in some haste.

Ten minutes' work in the laboratory identified the "silver" solution as aqueous mercuric nitrate.



Nine grades of Dicalite filteraids give desired clarity and wide range of flowrates to insure uniform quality and maximum production under today's conditions.

The shape and type of the diatoms are the "key" factors in the efficiency of filteraids. Next in importance is preservation of this diatom structure and the methods used to develop the full filtering qualities of the materials. Dicalite filteraids are superior in both respects. Fourteen years' use in industry has proved their diatom structure (predominating in "acicular" and "elongated" diatoms) to be the most effective for filtration. Dicalite's modern production methods provide finished materials that not only give brilliant clarity of the filtrate but higher flowrates for maximum production and lower costs. Dicalite Bulletin B-10, giving the "story" in detail, sent on request without charge.

THE DICALITE COMPANY

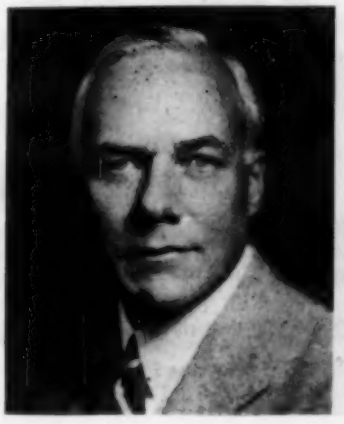
CHICAGO, 11 • NEW YORK, 5 • LOS ANGELES, 14

DICALITE FILTERAIDS

NAMES IN THE NEWS

Lawrence W. Bass

Everett C. Hughes



Albert B. Newman

Lawrence W. Bass, associate director of chemical research, Air Reduction Co., and U. S. Industrial Chemicals, Inc., has been elected president of the American Institute of Chemical Engineers for 1944. The election of Dr. Bass was announced in St. Louis, November 19, at the fall meeting of the Institute.

Bradley Dewey, president of Dewey and Almy Chemical Co., and former Rubber Director, has been awarded the 1944 Chemical Industry Medal of the American Section of the Society of Chemical Industry.

Gregoire Gutzeit, formerly with the Dorr Co., has been appointed research director of General American Process Equipment, a division of the General American Transportation Corp.

A. E. Buchanan Jr., has been appointed assistant manager of the Rayon Technical Division of E. I. du Pont de Nemours & Co. Until now he has been manager of the Technical Division of the Remington Arms Co.

Felix N. Williams, general manager of Monsanto Chemical Co.'s Plastics Division at Springfield, Mass., has been elected a vice president of the company.

Gerald J. Leuck has been appointed director of research of Glyco Products Co.

Warren R. Philbrook, formerly manager of the Carteret, N. J., plant of Westvaco Chlorine Products Corp. has been appointed industrial relations director for all Westvaco plants.

Marcus O. Orr has been named technical superintendent of Mill 4 of the B. F. Goodrich Co. Mr. Orr is a chemical engineering graduate of Dennison University.

George D. Creelman, formerly with Monsanto Chemical Co., has been named administrative assistant to the director of the Institute of Gas Technology.

Everett C. Hughes has been appointed chief of the research division of the manufacturing department of the Standard Oil Co. (Ohio). Dr. Hughes has been associated with Standard Oil of Ohio since 1930.

Luke H. Sperry has been appointed to the position of director of engineering for Hercules Powder Co., and **Ernest S. Wilson** has been made chief engineer of the company. Mr. Sperry has been associated with Hercules for 26 years and chief engineer of the company since 1939. Mr. Wilson joined Hercules in 1923, and has been assistant chief engineer since 1939.

E. T. Handley has been appointed general manager of synthetic rubber operations for the Firestone Tire and Rubber Co., as manager of the $4,500,000 tire plant which the company is building for the government and will operate at Des Moines.

Harry Gehman has been named assistant director of research at the Argo Laboratories of the Corn Products Refining Co. Before coming with Corn Products Refining Co., Dr. Gehman was employed in the Rayon Department of Du Pont, and by Armour & Co..

H. R. Dinges, of the Mathieson Alkali Works, has recently been placed in charge of technical service on Textone applications in Southern textile industries.

Homer E. Kieweg has been appointed manager of the penicillin plant of Commercial Solvents Corp. at Terre Haute, Ind. He was previously a member of the chemical engineering staff and has been with Commercial Solvents since 1932. Mr. Kieweg received his degree in chemical engineering from the University of Wisconsin.

Joseph H. Hart, chief chemist of Kelite Products, Inc., Los Angeles, has been promoted to the position of laboratory director.

Albert B. Newman, dean of engineering and professor of chemical engineering, C.C.N.Y., has been elected vice-president of the American Institute of Chemical Engineers. The election of Dr. Newman was announced in St. Louis, November 19, at the fall meeting of the Institute.

A. A. Orlinger, patent counsel for Sharp & Dohme, Philadelphia, has been appointed chairman of the Patents and Trade-Marks Committee of the American Drug Manufacturer's Association.

Charles M. Switzer, director of cellophane production for E. I. du Pont de Nemours & Co. since 1935, has been appointed director of nylon production. **J. F. McCune,** superintendent of the cellophane plant at Clinton, Iowa, succeeds Mr. Switzer as director of cellophane production, and **F. W. Barkley,** assistant superintendent at Clinton, replaces Mr. McCune as superintendent. **D. B. Campbell,** assistant superintendent of the cellophane plant at Buffalo, N. Y., is promoted to superintendent of that plant to take over duties of **A. T. Twing,** who is now on an extended leave of absence.

John A. Sargent has been appointed planning engineer for the Ansul Chemical Co. and its Dugas Division. He was formerly assistant manager of the Menominee and Marinette Light & Traction Co., a subsidiary of the Wisconsin Public Service Corp.

Arthur V. Danner has been appointed executive vice-president of the Houdry Process Corp., Wilmington, Del., and **Robert B. Cragin** has been named vice-president in charge of sales engineering and a technical advisor of the corporation.

Elmer Stewart, solicitor of patents in organic chemistry in the office of the Alien Property Custodian for the past two years, has resumed his private practice of patent and trademark law with offices in Washington, D. C.

Robert E. Wilson

Robert E. Wilson, now president of Pan American Petroleum and Transport Co., will become chairman and chief executive officer of Standard Oil Co. of Indiana on January 1. On that date **Edward G. Seubert** will retire from the presidency and **A. W. Peake**, now vice president, will become president.

Blythe M. Reynolds has been named director of engineering for Merck & Co.

Walter E. Flumerfelt has been named a vice-president of the vegetable oil and protein division of General Mills, Inc. He will continue to manage the division's operations at Belmond, Iowa.

David W. Choate has been transferred from Milwaukee to Atlanta to serve as industrial manager of the Atlanta branch of Brown Instrument Division of Minneapolis-Honeywell Regulator Co.

M. R. Stanley has resigned his position as deputy chief of the acids and salts section of the Chemicals Bureau of WPB and has returned to Chicago to resume his duties in the executive offices of Victor Chemical Works, with whom he has been affiliated for over 21 years.

William B. Lodder has joined the headquarters staff of the Washington office of the American Chemical Society as technical assistant. Mr. Lodder comes to ACS from the Diamond Alkali Co., where he was a senior chemist specializing largely in problems dealing with technical service.

J. French Robinson, president of the East Ohio Gas Co., Cleveland, Ohio, was elected president of the American Gas Association at the annual business meeting in New York, October 5.

Milton Harris announces his resignation as director of research of the Textile Foundation and the Textile Research Institute to become effective Jan. 1, 1945. At that time he and a number of members of the staff who have been working with him will continue their activities in a research and consulting organization to serve the textile and allied industries under the name of the Milton Harris Associates. The laboratories will be located in Washington.

John W. Sands

John W. Sands, who has been with the Conservation Division of WPB since January, 1942, has resumed his duties with the development and research division of the International Nickel Co. at New York.

E. M. Flaherty has been appointed manager of the finishes division of the fabrics and finishes department of E. I. du Pont de Nemours & Co.

Richard J. Murtagh, formerly with the Hercules Powder Co., is now chemist for the Taggert Corp., Oswego, N. Y.

Stanley F. Maclaren, formerly with the Hooker Electrochemical Co., is now president of the Regent Pulp and Chemical Co., New York.

A. F. Sprankle has been appointed metallurgical engineer in the Timken Steel and Tube Division of Timken Roller Bearing Co. He was formerly manager of the Alloy Bureau of Carnegie-Illinois Steel Corp.

H. B. Higgins, president of the Pittsburgh Plate Glass Co., has been elected president also of the Pittsburgh Corning Corp., replacing the late **H. S. Wherrett.**

Richard M. Hitchens has been promoted to the position of associate research director of Monsanto Chemical Co.'s Organic Chemicals Division. Dr. Hitchens has been with Monsanto since 1931, having started as a research chemist and later becoming a research group leader.

The Chemical Warfare Service Roll of Honor contains the following names of chemists and chemical engineers: **Major Ronald Q. Smith** and **Col. Maurice E. Barker** have received the Legion of Merit; **1st Sgt. Harry Cohen** has received a soldier's medal and silver star; a silver star has been awarded to **Lt. Col. William S. Hutchinson, Jr.,** and **1st Lt. Andre N. Laus.**

Arnold J. Veraguth has been appointed to the research staff of Battelle Memorial Institute, Columbus, and has been assigned to its division of organic chemistry. Dr. Veraguth was previously associated with the Hercules Powder Co.

OBITUARIES

Fin Sparre, 65, a director of E. I. du Pont de Nemours & Co., and for 25 years director of its development department until his retirement from that position on August 31, died of a heart attack October 7 at his home in Wilmington.

Warren L. Beuschlein, 49, professor of chemical engineering, University of Washington, Seattle, died September 15.

Beram D. Saklatwalla, 63, chairman of the Alloys Development Corp. and well-known consulting metallurgist, was killed in a plane crash in California November 4.

Charles K. Williams, 82, chairman of the board and treasurer of C. K. Williams & Co., manufacturers of dry-colors and chemicals, died October 12 at his home in Easton, Pa.

Earl Charles Sherrard, 58, who had been associated with the U. S. Forest Products Laboratory since 1917, died October 5 of a heart attack in Madison, Wis. For the past 14 years Dr. Sherrard was in charge of research in the chemistry of wood and its derived products.

William Bausch, 83, chairman of the board of Bausch & Lomb Optical Co., died at his summer home near Rochester, N. Y., October 19.

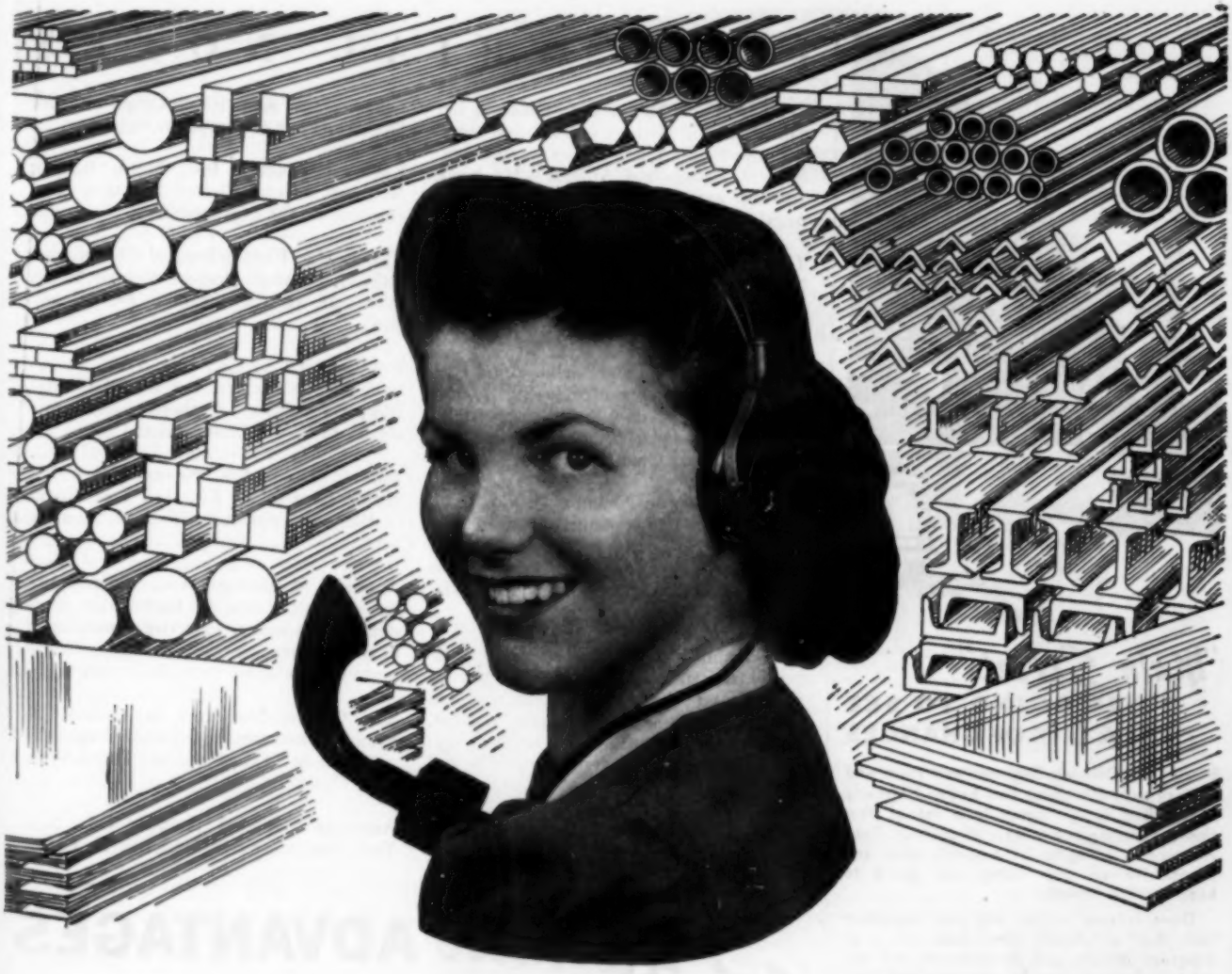
George A. Martin, 79, chairman of the board of Sherwin-Williams Co. and president of Sherwin-Williams Co. of Canada died in Cleveland November 1.

John T. Tierney, 61, president of the Koppers United Co. and chairman of the board of the Koppers Co., Pittsburgh, died October 25.

Frank A. Merrick, 75, president of the Westinghouse Electric & Manufacturing Co. of Pittsburgh from 1929 to 1938, died in Hamilton, Ontario, October 26.

Thomas Midgley, Jr.

Thomas Midgley, Jr., 55, vice president of Ethyl Gasoline Corp., vice president of Kinetic Chemicals, Inc., and president of the American Chemical Society, died at his home November 2.



Call Ryerson When You Need Steel

Every type of steel from stainless to structurals is immediately available from Ryerson stock. Just reach for the phone and call any one of the eleven conveniently-located Ryerson service plants. Our operators will connect you at once with an experienced service man who will see that you get the steel you need—when you need it.

JOSEPH T. RYERSON & SON, INC. Steel Service Plants: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston.

QUICK, DEPENDABLE SHIPMENT

INDUSTRIAL NOTES

Republic Flow Meters Co., Chicago, has named Merrill Berkley as exclusive representative in Southern California and portions of Nevada and Arizona. His headquarters are at 742 So. Hill St., Los Angeles.

The Kennedy Valve Mfg. Co., Elmira, N. Y., has elected Leon H. Marsh vice president in charge of sales and public relations.

American Machine and Metals, Inc., East Moline, Ill., has appointed Joseph G. Magrath manager of its Chicago district sales territory. Headquarters are at 310 South Michigan Ave., Chicago.

E. I. du Pont de Nemours & Co., Inc., Wilmington, has appointed Clifford McIntire assistant to the general manager of the Grasselli chemicals department. He is succeeded as director of sales by T. H. McCormack.

Allis-Chalmers Mfg. Co., Milwaukee, recently announced two sales manager appointments. C. C. Van Zandt now has charge of sales of the crushing, cement, and mining section and H. K. Swan has charge of milling and oil extraction and saw and pulp mill sections.

Ansul Chemical Co., Marinette, Wisc., has changed its owned and operated subsidiary, Dugas Engineering Corp., into the Dugas division of the parent company.

Kieley & Mueller, Inc., North Bergen, N. J., has selected Clifford B. Ives as chief engineer of the organization.

The Hooker Electrochemical Co., Niagara Falls, has added Herbert Heesch to its sales staff in the northern New Jersey area.

Continental Can Co., New York, has acquired the assets and business of Owens-Illinois Can Co., a wholly owned subsidiary of Owens-Illinois Glass Co.

John C. Dolph Co., Newark, N. J., has placed Charles H. Kinzel, Jr., in charge of the sales promotion work of the company.

American Engineering Co., Philadelphia, has elected Allison L. Bayles vice president. In addition to active management of the company, he will be responsible for postwar developments of its products.

Shell Oil Co., New York, has named J. S. Sawyer as manager of the asphalt sales department to succeed the late David Waxman.

American Car and Foundry Co., New York, has transferred Frederick H. Eaton,

sales engineer, from Washington to the New York office.

Wickwire Spencer Metallurgical Corp., New York, has named Evelyn S. Carlson to the position of sales and production coordinator at its plant in Newark, N. J.

Hercules Powder Co., Wilmington, has announced that the Paper Makers Chemical division will discontinue the resale of a number of industrial chemicals made by other manufacturers in order to concentrate technical service and sales on products of Hercules' own manufacture.

Latrobe Electric Steel Co., Latrobe, Pa., has appointed Victor F. J. Tlack consultant and special representative of the sales department. He will make his headquarters at the company's office in Cleveland.

Mathieson Alkali Works, Inc., New York, has transferred L. E. Russell and Vernon Woodside from the sales development and technical service department to the laboratories in Niagara Falls. Mr. Woodside will specialize in technical service to the pulp and paper industry and Mr. Russell will conduct market surveys on new Mathieson products.

U. S. Industrial Chemicals, Inc., New York, has promoted Milton F. Martin to the position of assistant general sales manager.

Conoflow Corp., Philadelphia, has been formed with offices and manufacturing facilities at 2100 Arch St. R. B. Werey is president of the new company which will manufacture and market devices for the regulation and control of flow.

H. K. Porter Co., Pittsburgh, has opened offices in the Petroleum Bldg., Los Angeles, and appointed Harold A. Hintz district manager for that territory.

Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co., Pittsburgh, has advanced J. E. Brown, veteran sales executive, to the position of assistant to the general sales manager.

The Emulsol Corp., Chicago, has placed E. S. Thayer in charge of sales of its technical products division.

General Controls Co., Glendale, Calif., has opened a branch office at 421 Southwest Blvd., Kansas City 8, Mo., with Robert Courtney in charge as branch manager.

The Patterson-Kelley Co., Inc., East Stroudsburg, Pa., has appointed the Mid-Coast Sales Co., Esperon Bldg., Houston, Texas as sales representatives in Texas, Louisiana, and Oklahoma.

The Timken Roller Bearing Co., Canton Ohio, has appointed Howard C. Sauer general manager of its newly formed foreign division.

American Standards Association, New York, has moved to larger quarters at 70 East 45th St.

CONVENTION PAPER ABSTRACTS

CONTENTS

Research Makes Jobs 177
Polymers 178
Water Purification 179
Waste Gas Disposal 179
Cellulose Plastics 181
Research Defined 182
Inks 183

RESEARCH MAKES JOBS

THERE can be no victory in this war if its end brings widespread unemployment and want in the United States. Even now we take counsel and consider the changes that must come with peace. As a people, we are as united in the objectives of this postwar effort as we are in our determination to crush Germany and Japan.

Near the top on everyone's list is the hope for a high level of productive employment—for an economy that will provide jobs for our returning veterans, for those now making war materials and for the youth that will come to maturity in the happier years which will follow the war. There is ample ground for entertaining such hopes. Research has provided millions of jobs in the past, and there is reason to believe it can do it again.

Great research laboratories which have been established in America since the last war represent a national asset of extreme importance in the solution of future problems, particularly the problem of providing adequate employment at our high American standards.

Our high standards of living, and our hope for the future, lie in our productivity. This is the key word of our whole industrial mechanism. The thousands of people making cellophane, nylon and neoprene, for example, hold jobs that at the end of the last war did not exist; and they are good jobs. Why are they good jobs? Why does an American workman earn more in one day than his Oriental counterpart earns in a month? The big reason is that he produces more.

He produces more because of the research and the investment in tools and equipment that go into the making of his job, because of the technology that stands behind him, because of the skill that he has acquired. How much technology stands behind the Oriental carrying imported coal on his shoulders over a mountain range ribbed with some of the richest untouched coal veins in the world? He is not productive because he lacks the backing of a free science in a free land.

American technology is what enables industry to maintain and constantly raise its standards, to pay high wages and still produce at continually lower cost, making its goods available to everyone.

In the chemical field, the American

workman is backed up by a research force that has become a new power in the world during the last two and a half decades—a research force that has destroyed forever the old myth of German technical supremacy.

Here in the United States we have more than 70,000 research workers in 3,400 industrial laboratories, many engaged in chemical research. From these laboratories have come thousands of new chemical compounds. The American chemical industry has outstripped that of any country in the world.

In the postwar period, it remains for us to consolidate our gains, to continue our advance and to create a permanently fruitful economic structure. The means are at hand. It is science, it is investment in tools and equipment, and it is the American people together that can put these means to use.

Cole Coolidge, E. I. du Pont de Nemours & Co., before New York Herald Tribune Forum, New York, Oct. 16, 1944.

POLYMERS AND COPOLYMERS

It is now generally recognized that most high polymers of the thermoplastic type consist of long hydrocarbon chains with certain chemical groups substituted at regular intervals along the chain. For a given polymer, once a certain chain length is reached, mechanical properties become relatively independent of further increase in chain length. Most commercial molding powders represent intermediate chain length materials where properties have begun to level off and no longer increase as a result of increasing chain length. Aside from solution viscosity and melt flow characteristics, such properties as refractive index, softening point, and tensile strength are largely independent of molecular weight and molecular weight distribution for commercial polymers.

One plastic differs from another primarily in the nature of the chemical group attached to the hydrocarbon chain. While there may appear to be a large number of different plastics, yet the actual number is relatively limited by both chemical and economic factors. When, however, we go to copolymers which have two or more different chemical constituents alternating around the chain, the number of possibilities quickly becomes enormous, even with the present number of commercial monomers.

Copolymers allow one to build up a plastic material having almost any desired set of characteristics. The behavior of copolymers is not a simple additive function of their chemical composition but is more analogous to the case of metallic alloy systems where a small amount of an added constituent can influence mechanical properties all out of proportion to the amount present.

Three component systems show considerably more complexity than a two-component system and one can begin to tailor a plastic molecule to fit any desired requirement. This field is relatively new, but the preliminary results are quite promising and indicate that more and more the plastics industry will be moving away from simple polymers into multi-component polymers.

Actually the problem of designing plastics for specific applications may not be as simple as indicated. One must choose not only the correct ingredients, but must also determine by patient trial and error the exact proportions of each to use. Moreover, the new ingredients in the copolymer must not achieve the final result at a sacrifice of other desired properties.

R. F. Boyer, Dow Chemical Co., before Plastics Paint & Varnish Section, Canadian Chemical Conference, Toronto, June, 1944.

WATER PURIFICATION

A NEW process for water purification, developed by The Mathieson Alkali Works for the removal of "chlorphenol" taste and odor, consists of pretreatment with chlorine to sterilize the water, followed by treatment with chlorine dioxide to remove taste and odor caused by phenolic waste. The chlorine dioxide is generated by dispensing a sodium chlorite solution into the discharge line of a Wallace and Tiernan chlorinator. A constant dosage of 0.5 ppm. available chlorine is maintained, which is sufficient to remove all taste in a severely contaminated water.

Following experiments with the process on a laboratory scale, plant-scale operations were carried on at an auxiliary filter plant of the City of Niagara Falls Water Department. This plant, which supplies 3 to 8 million gal. of water per day, has an "on-shore" intake which often became so contaminated with phenolic compounds that the customary method of treatment was inadequate. Variations in the degree of contamination aggravated the problem.

Three months of operation with the chlorine dioxide process demonstrated that it destroys phenolic taste and odor permanently and completely. Additional advantages claimed for the process are considerbly reduced chemical costs and simplified plant operations. The process is now used for purification of the entire Niagara Falls water supply.

G. P. Vincent, Mathieson Alkali Works, before American Chemical Society, New York, Sept. 15, 1944.

SAFE DISPOSAL OF WASTE GASES

ATTACK by means of poisonous gases has become an ever present threat to armies, navies and civilian populations of all nations; a threat that requires elaborate measures of defense. Gas hazards of modern industry and the defenses against them are no less important. The present emergency has required the manufacture of many new products which are either gases, are made from gases or produce gas as a byproduct. Such of these gases as are flammable or toxic should not be released to the atmosphere in concentrations where there might be harmful effects to the plant workers or civilian population in nearby areas or create a fire hazard.

In general, and particularly when the value is not great, small and intermittent quantities of flammable or toxic gases may be released at points sufficiently high to permit complete diffusion before reaching the ground.

Large quantities of both toxic and flammable gases must be neutralized or destroyed. If this can be done by con-

verting them into useful products or by utilizing the heat units they contain, so much the better.

In a study of gases that may be disposed of by diffusion and dilution or by burning there are two major divisions to be considered: (1) Continuous disposal of a byproduct gas which is produced at a fairly even rate; (2) disposal of gases due to unusual operating conditions such as the gases released from pressure vessels or distillation columns through safety valves which have to be vented quickly to relieve pressure build-up.

In the first case, continuous disposal of both flammable and toxic gases may be effected through the use of a special combustion furnace provided and designed specifically to destroy them by burning. In a great number of cases, however, where the flow is continuous and fairly constant, it is advantageous to pipe the gas to boilers or other combusion chambers where the heat generated by burning can be utilized.

If the waste gas is subject to fluctuation in volume, it may be best to provide a separate disposal furnace or a blowdown stack where the release point is elevated and equipped with a pilot light that will burn and destroy the gases as they are released to the air. Such blowdown stacks are particularly applicable where the volume or nature of the gas released is unexpected or unpredictable and where it must be released rapidly in cases of emergency. Such blowdown stacks should be installed at a safe distance from any operating equipment to minimize all exposure hazards.

Where a large number of safety valves or other relief devices is necessary to relieve excess pressure in the event of abnormal operating conditions and where it is undesirable to release this gas to the air in the immediate area, the installation of a header gathering system is necessary. It is important that provisions be made so that each safety valve or device may be tested periodically.

Another important feature in connecting the outlets from safety devices to a common vent leader is to eliminate all stresses in the connecting piping. Experience has shown that such stresses will affect the operation of the safety device and in some cases prevent it from functioning. Probably the best method is to utilize flexible connections between the safety device and the vent header.

Another important feature with regard to a vent header system is the necessity of preventing the propagation of flame from the point of discharge back through the header. This can be accomplished by utilizing a continuous flow of an inert or flammable gas through the header system at all times to keep the entire system free of oxygen.

Diffusion and dilution or burning are not the only ways in which flammable or toxic gases may be safely disposed of. Many gases will react with other elements or compounds to form products of value. As an example, one can cite the production of sulphuric acid from the sulphur dioxide and sulphur trioxide in the flue gases from smelters.

Mention should also be made of the

fact that certain gases and chemical vapors such as chlorine, bromine, ammonia and sulphuric dioxide can be prevented from escaping into the air by providing scrubbing towers with the proper absorbents. The usual absorbents are acids, alkalis, charcoal and activated carbon.

All in all, knowing the kind and amount of gas, a little research should enable one to develop a method of safely disposing of it, usually at a profit.

H. F. Reinhard, Linde Air Products Co., before joint meeting of the Chemical Section and the American Society of Safety Engineers at the National Safety Congress and Exposition, Chicago, Oct. 5, 1944.

RECENT DEVELOPMENTS IN CELLULOSE AND LIGNIN PLASTICS

CELLULOSE nitrate, oldest of commercial derivative plastics, is still an active article of commerce in spite of its many shortcomings. Research is directed toward improving compositional stability. By using plasticizers containing chlorine and phosphates, flammability can be reduced but only at the expense of mechanical strength.

Recent solution of technical difficulties has permitted wide use of high-acetyl cellulose acetate, a material noteworthy for its good moisture resistance and dimensional stability. Another recent development is the improvement made in outdoor aging characteristics of certain cellulose acetate compositions; improvements of over 100 percent in discoloration and crazing are claimed.

Most significant innovation in the mixed-ester field was the introduction in 1941 of acetate-butyrate dry extruded fiber. When woven, these fibers are useful in such items as belts, handbags, millinery, and costume jewelry. Other esters have been studied but for economic reasons have not received broad industrial application. Four new ethyl cellulose plastics have been developed during the last two years. One, called "ethyl rubber," is quite elastic and flexible and can sometimes be used instead of rubber. The second preserves impact resistance and toughness in molded articles at temperatures as low as −78 deg. F.; such moldings are also dimensionally stable at 160–180 deg. F. at 100 percent relative humidity. Third is a hot melt containing ethyl cellulose; metal parts dipped in the melt are coated with plastic and protected against corrosion during storage or shipping. Fourth is an ethyl cellulose compound which can be heated and poured into molds for forming dies, jigs, and fixtures in the fabrication of aircraft parts.

Benzyl cellulose, developed and exploited in England, has excellent water resistance and electrical properties, but because of a low softening point and poor stability its usefulness will be limited. Methyl cellulose has a high melting point which rules it out as a plastic, but it finds application in pharmaceuticals, adhesives, thickening agents, and sizing agents. Carboxy-methyl cellulose, together with its sodium and aluminum salts, is expected to find use in the pharmaceutical, food, paper, and textile industries.

Recent advances have evolved high tenacity rayon yarn, more delicate fabrics,

improvement in wet strength, wrinkle resistant fabrics, and utilization of the thermoplastic nature of cellulose derivative rayons to produce laminated fabrics and to eliminate stitching in fabrication.

The Marathon Corp. and the Meade Corp. are currently producing from spent pulp liquors a lignin material which is suitable for plastic manufacture. Two other processes, Sherrard in America and Losey in Russia, utilize lignin for plastics by converting *in situ* in wood to form a moldable material; both these processes, however, depend upon the addition of other resin forming materials, such as formaldehyde, to supplement resins already in the wood. Up to now, attempts in Russia, Germany, and America to produce a moldable compound without the addition of other resins have been notable for their lack of success. Recently, however, Dow Chemical Co. has developed a process whereby wood may be converted, without addition of other resins, into either moldable sheets or a moldable powder. Another development is the use of lignin-phenolic resins as extenders for urea-formaldehyde and phenol-formaldehyde resins; up to 50 percent of phenolic solids may be replaced by lignin-phenolic resins.

Although less than 500,000 lb. of phenol-furfural resins were produced in 1943, the characteristics of these resins insure an increase in postwar production. During the war phenol-furfural resins have been used as alternates for the very critical phenol-formaldehyde resins. The pulp and wood industries might well consider entering the furfural field since wood, especially hardwood, contains large amounts of hemicellulose (pentosans) which can be converted to furfural. Little success has attended efforts to convert the pentosans in wood to furfural and condense it *in situ* with phenol.

The phenomenal growth of the plastics industry and the position of cellulose derivative plastics in the industry are reflected in the following figures on production:

Year	Total Plastics, lb.	Cellulose Plastics, lb.
1920	20,000,000	20,000,000
1930	30,000,000	15,000,000
1940	300,000,000	70,000,000
1944 (est.) ..	800,000,000	140,000,000

While no one doubts that the industry will continue to grow, neither molders nor raw material producers subscribe to the opinion that we shall soon be living in a Plastic Age with little need for familiar materials like wood, steel and glass. Predictions by 446 research directors in the plastics field indicate that greatest growth may be expected in the field of vinyl, styrene, acrylic phenolic resins and cellulose derivatives (other than nitrate) in the order named.

Floyd C. Peterson, Dow Chemical Co., before New Developments in Wood Products Conference, Syracuse, N. Y., Oct. 7, 1944.

INDUSTRIAL RESEARCH DEFINED

RESEARTH in very broad terms may be defined as systematically setting out to find out something new and worth knowing. Under this definition research is something much more universal than what goes on in a scientific laboratory or in a

plant. It includes, but is not limited to, the development of new products and new processes. It can go on in a sales department in the form of market surveys and the like. It can go on, without the help of any apparatus whatever, in the mind of a salesman on the road. It can, and indeed must, go on plentifully in every personnel department in the country, both with respect to hiring, firing, job specification setting, rate setting, and a lot of other personnel techniques, and particularly now-a-days with respect to employer-employee relations. It can go on with respect to all the various aspects of management and at all levels of management, right up to the policy-setting level sometimes called administration.

In other words, research is not a particular kind of activity; it is a state of mind. The spirit of research never assumes that because something has been it is necessarily the best that could be. Often it is, but the possibility of improving it is always worth thinking about. The spirit of research is an imaginative asking of a lot of significant questions, coupled with a yearning for as much knowledge as can be had before one reaches a conclusion. Both this imagination and this yearning for facts is, or should be, characteristic of technically trained men. But remember, also, that a good research man often gets some of his most useful facts by means of a literature search in the library, or by conversation with others, as well as by experimentation on his own hook; so never ignore the accumulated wisdom of the race. But never swallow it whole.

Harvey N. Davis, president, Stevens Institute of Technology, at Stevens commencement exercises, Oct. 28, 1944.

INK CHEMISTRY

WHEN a person writes with a fountain pen, or a steel pen filled with ink, he is using a method of transferring thoughts to paper which has been in existence for many centuries. Present-day writing inks may be classified as follows:

1. Blue-black-permanent. Writes blue and oxidizes to black color. Made with tannic-gallic acids, iron sulphate, and aniline blue.

2. Blue-permanent. Writes blue but does not change its original color. (a) Made with metallic gallotannates and pararosanilin blue. (b) Made with soluble Prussian blue. Writes blue, stays blue. Made with ferrocyanide group. Soluble in oxalic acid.

3. Blue-washable for school and college use where permanent records are not required. Water removes writings. Made with acid and basic blues. Not fast to water on writing paper.

4. Black-permanent. Writes black, becomes blacker by age. Good for V-mail letters. (a) Made with gallotannate of iron base with a 3 to 4 aniline color combination. (b) Made by oxidizing logwood extract (hematoxylin) with chromate of soda to hematin, producing a purple-black color.

5. Black-washable. A popular public school ink. Made with blue and jet shades of nigrosin and indulin.

6. Colored inks. In this class are the permanent and washable reds, green, violet,

and brown. Used in business for bookkeeping and contrast work in department offices. These inks are made with acid and basic aniline dyes which contain organic radicals that are capable of combining with mordants to fix the colors on the fiber of the paper.

7. Recording gage pen inks. The use of this class of ink is tremendous now because of war industrial plants with hundreds of recording instruments. The ink specifications require pure colors and materials, and tests are made for viscosity, speed of penetration, time of drying on charts, and absence of offsets on crossed-line tracings by the recording pens.

8. Indelible writing inks. Made especially for laundry work, where fastness to hot water, soap, and bleaching chemicals is required. Alcohol-soluble aniline colors of high purity and strength are used with special distilled coal-tar solvents.

9. Drawing inks. Made for draftsmen and artists in newspaper and photographic work. The ink formulas are the result of hundreds of experiments to obtain the finest particle size and uniform dispersion of carbon black in certain vehicles miscible with water. All these drawing inks must be waterproof on tracing cloth and paper. The colored inks are made with selected alkali-soluble dyes.

10. Show card and poster inks. Posters and cards are drawn and lettered with special pens with these so-called pigment inks. In this class of inks also belong those made with gold and silver bronze. White writing ink is used largely for marking in photographic albums and sketching on dark-colored papers.

11. Hektograph and duplicator writing inks find extensive use in making copies from one master writing on gelatin-coated cloth.

12. Invisible writing ink. These are made with chemical salts which develop color by heat, ammonia, or sulphide fumes. Starch and dextrin writings are made legible by iodine vapors.

These 12 classes of writing inks are made from secret formulas and therefore can be mentioned only in a general way their ingredients or process of manufacture. The best-known tannin, gallotannic acid, of formula $C_{14}H_{10}O_9$, is obtained from Turkish aleppo, Chinese, and Japanese gall nuts. By special extraction methods, the finely ground galls give a tannic acid extract. Gallic acid, $C_7H_6O_5$, is obtained from gallotannic acid by fermentation or by the hydrolytic action of dilute acids. Tannic acid reacts with ferrous sulphate to give a brown-black color due to ferrous tannate. Gallic acid gives a blue-black color of ferrous gallate with the same salt. Air oxidation of these compounds gives the principal indgredients of the iron inks.

The chemistry of writing inks is knowledge acquired by the ink chemist over a period of many years of research and experience in the manufacture of these inks. Laboratory control of materials and products tested against standards requires scientific knowledge, as millions of bottles are used every day for every purpose of writing.

Charles A. Schmitt, Carter's Ink Co., before New England Association of Chemistry Teachers, Boston, May 6, 1944.

RUSSIA

Threat . . . or Promise?

WHEN this war is ended, two nations—the United States and Russia—will possess the bulk of the world's military and industrial might.

Whether this new situation will hold seeds of catastrophe or of unprecedented opportunity will be determined by policies . . . still to be formulated.

If this concentration of power leads to a bitter struggle for supremacy, then the world will be turned into a giant munitions factory.

If it is used cooperatively to maintain order, then, I believe, the stage is set for a long era of prosperity . . . and peace.

It is time that Americans, whether of the Right or the Left, face this basic issue squarely and open-mindedly.

☆ ☆ ☆

No group in this country has a greater stake than have business and industry in seeing that a satisfactory Russian-American understanding is reached.

Without such an understanding there can be no reasonable hope for more than a temporary and insignificant reduction of our crushing wartime tax burden. If the threat of a clash between these two giants impends, neither bankers nor governments will run the risk of lending on a scale adequate to maintain international trade at levels necessary for our future prosperity. Potential international customers, instead of buying freely in open world markets, will be forced—as during the dangerous period introduced by Hitler in the early 1930's—into the trading camp of whichever power they fear most.

If, however, Moscow and Washington will agree on cooperative plans for maintaining the peace, American business will enjoy enormous new trade opportunities after the war.

☆ ☆ ☆

Russia, during the three and one-half years since it was attacked by Hitler, has conclusively proved to a doubting world that it is a top-flight military power.

Soviet railroads did not break down under the strain of war.

Regions accounting for nearly 70 per cent of Stalin's key industries were engulfed by the invading Nazis, but before they fell, Soviet management engineers performed a near miracle by transplanting entire industries a thousand miles to the Urals with the loss of as little as four months' production in many cases.

Though American planes, trucks, and medical supplies have been welcomed by Moscow, fairness demands the admission that more than 98 per cent of American production has *not* gone to the Russian front.

Russian planning and *Russian* equipment won the victories of Leningrad, Stalingrad, and the Caucasus.

☆ ☆ ☆

But these measures of Soviet military strength—indicative as they are of an unsuspected economic development—fail to picture in adequate detail the startling potential of the Russian market after the war.

Russia, for instance, has two and one-half times the area of the United States.

It has a population of nearly 200,000,000, and this is increasing at the rate of 2,500,000 a year.

And statistics just released show that Russia has three times as many youngsters under 16 as has the United States. This is a measure both of war potential and of a vast commercial market.

And remember that in no part of the world before the war was per capita production rising as rapidly as in the Soviet Union.

☆ ☆ ☆

German armies occupied a region in Russia roughly equivalent to the territory in the United States north of Richmond, Virginia, and east of the Mississippi.

This huge area—with its counterparts of Pittsburgh, Buffalo, and Bridgeport; of Illinois corn fields, New York dairy farms, and Maine potato harvests—was *twice* subjected to the most withering destruction; first by the Russians themselves when they retreated before the Germans, and then by the Germans when they withdrew before the victorious Russians.

As a result, 30,000,000 people are in urgent need of complete reoutfitting. They need houses and shoe laces, trolley cars and baby carriages, tractors and livestock, hydroelectric plants and electric light bulbs.

Many of these needs will be met at home. It is doubtful, for instance, if Moscow will import cooking utensils or sewing machines, for many of Russia's huge war factories can quickly be converted to peacetime production of such consumer goods.

But for the rebuilding and expansion of her industries Russia looks to the United States for equipment.

Soviet representatives already are in this country with authority to negotiate for technical men and the equipment necessary to rebuild the great Donbas coal mines according to the most modern American methods.

It is important to remember that Russia's whole iron and steel industry, its non-ferrous mining and processing, some of its chemical production, much of its coke roasting and gas recovery, practically its entire automobile and tractor industry, and the largest of its hydroelectric plants, are based on American machinery and processes.

It is known among manufacturers that Russia recently has asked for bids on shipbuilding equipment, construction and roadbuilding machinery, alloy steels, textile machines, plastics, and a long list of rail, air, and water transport supplies.

☆ ☆ ☆

The Soviet Union, however, has more than a rehabilitation job on its drawing boards.

The first Five-Year Plan, which, as we all remember, was completed ahead of time in 1932, was devoted almost exclusively to heavy industry. Russia set out to build for itself the machines and the factories which, in later years, could turn out, at home, modern equipment for a vast range of light industries.

Stalin, when he inaugurated the second of his famous Five-Year Plans, promised that before it was completed Soviet factories would begin to turn out a flow of con-

sumer goods—ready-made dresses, canned foods, soap, cosmetics, shoes, kitchenware, automobiles, telephones, and modern houses.

But, by 1935, Moscow realized that Russia could not afford to enjoy such luxuries in the face of growing political tension in Europe. So, when the third Five-Year Plan was launched, there was no fanfare. Russians continued to wear their old clothes, to eat whatever simple food was available, and began grimly to build the industries which ultimately produced enough tanks, planes, and guns to turn the tide of battle at Stalingrad.

It is characteristic of Moscow that even before the last battles with the Nazis are over, Russia is planning to pick up its Five-Year Plans where the war had interrupted them.

Invitations to participate in a permanent exhibition in Moscow already have been mailed to American manufacturers. Soviet officials want their public to see samples of our new machine tools, aluminum and alloy products, oil-drilling machinery, bulldozers, and prefabricated kitchen equipment. Russia already is projecting specific plans to resume the job (1) of making the country an industrial giant comparable to the United States, and (2) of making life more pleasant for a long-suffering people.

☆ ☆ ☆

What is the measure of this postwar market in the Soviet Union?

Some estimates place the total quantity of goods which Russia might take from the United States during the first two or three years after the war as high as $5,000,000,000 a year. Then, as Russian industry is restored, imports from the United States might taper off perhaps to $2,000,000,000 a year.

Actually, these estimates are far too optimistic, unless the United States is prepared (1) to help Russia pay by buying vast quantities of Soviet raw materials, and (2) to provide large credits to handle the purchases during the first few years of rehabilitation.

The relations of American exporters with Russia during the period covered by the three Five-Year Plans have been eminently satisfactory. Moscow has met all of its obligations punctually; fifteen years of experience have reduced contract forms to the point where they cause a minimum of misunderstanding between the Russian representatives and the American producers; individual American companies with extensive prewar experience in handling Soviet business already are offering large credits on initial postwar orders though these may yet be replaced by large government credits at lower interest rates.

But the volume of trade with Russia after the war hinges upon Moscow's ability to pay. Never before the war did the United States buy more than $30,000,000 of goods a year from Russia. As late as 1938, Soviet exports to this country amounted to as little as $23,500,000, far less than enough to pay even the service charges on the credits which would have to be extended in connection with exports of several billion dollars a year. Only South Africa produces more new gold each year than the Soviet Union. But the United States does not want gold; more of it would only complicate the problem of controlling prices here.

If the United States, however, is to achieve, after the war, the high level of national income which is necessary (1) to keep our expanded factories in operation, and (2) to service the national debt, it might absorb from $90,000,000 to $100,000,000 a year of the kind of goods bought from Russia before the war—furs, timber, manganese, chromium, and handicrafts. But unless this volume of purchases from Russia can be boosted by another $50,000,000 annually, credits of the size necessary to fill immediate Russian needs could not be serviced without large supplemental importations of undesirable gold.

The nub of the situation is that Russia offers an extraordinary potential market particularly for our heavy industries which have grown so enormously during the war. But if this sales outlet is to materialize, then the United States must find a way to import from Russia (or from Russia's debtors if any) from ten to twenty times as much as we did before the war. Instead of merely going after the export business, American businessmen must explore with the Russians the possibility of buying bigger supplies of Soviet products.

☆ ☆ ☆

But more than the Russian market itself hinges upon sound cooperative action by the world's two leading military-industrial nations.

If trade between them is held to a minimum and if relations are strained, the flow of trade all over the world will be adversely affected.

Europe, long this country's biggest export outlet, certainly will never take the bold steps necessary to reconstitute its economy on a peacetime basis if Russia and the United States drift into a race for military supremacy.

The Balkan states, which may be industrialized by Moscow in order to reduce their dependence on Germany, and the Arab world with its huge need for transportation, irrigation, and sanitation, will not dare accept American credits or make big contracts with American engineers if Moscow frowns on the deals.

And refusal of Russia and the United States to work cooperatively to maintain the peace would kill, in their present embryonic stage, all dreams of a vast industrialization program for China.

☆ ☆ ☆

The opportunity to make a major change in the trade map of the world and at the same time to achieve a sharp rise in our own standard of living is before us.

It demands of American business leaders the kind of boldness and imagination that their predecessors displayed when they pioneered this country's unknown West.

It demands realistic action by men who know that the solution to this country's *real* foreign trade problem under today's conditions lies in boosting *imports* not exports alone . . . men who are not afraid of being paid for what they sell.

It calls for leaders who will approach Moscow and other major customers at once with constructive plans that would parallel in scope those on which this country is waging war . . . leaders who will make it clear at the outset that this bid for cooperative action emphatically demands that each nation shall have complete freedom to determine its internal political and economic organization without interference from the other.

It is *this* caliber of leadership upon which our future hinges.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

FOREIGN LITERATURE ABSTRACTS

SENSITIVITY OF MIXTURES OF TNT AND POTASSIUM CHLORATE

SENSITIVITY of explosives to shock is determined by means of a device known as an impact hammer which consists of a steel base connected perpendicularly with two parallel graduated rulers between which a block of steel can be suspended at any given height and released instantaneously. The explosive is placed on the base and is subjected to the impact of the falling block. A block weighing 2 kg. was used to test the mixtures of trinitrotoluene and potassium chlorate studied in this report. The TNT used had a crystallization point of 80.5 deg. C. and the potassium chlorate was the pure product. The mixtures were made up in 0.05 g. batches packed in pieces of tin foil of approximately 1 sq.cm. each, and then dried 24 hr. in a desiccator containing calcium chloride. The samples were used only once, even if they did not explode in the first test.

Small additions of potassium chlorate to trinitrotoluene impart greater sensitivity than small additions of trinitrotoluene to the chlorate; the increase in the sensitivity of the TNT is considerable. In the first case, the decomposition begins by showing itself in an incipient form. Usually it is not audible and is recognized by the presence of smoke or by careful examination of the sample. In the second case, the decomposition caused by the impact is sudden and is even accompanied by considerable noise, although it is local. The most sensitive mixtures are those which contain the explosives in approximately equal parts.

Results of Tests Made With Varying Percentages of TNT

Percentages of TNT	Heights of Fall in cm.	Observations
100	80	Incipient decomposition
98	20	Same
96	16	Same
94	15	Same
92	15	Same
90	14	Same
80	14	Same
70	13	Same
60	12	Same; 3 series of measurements
50	11	Same
40	15	Same
30	20	Audible incipient decomposition; 4 series of measurements
0	26	Localised, stronger, 4 series of measurements
10	30	Same, 4 series of measurements
8	34	Same
6	39	Same
4	44	Same

Digest from "Sensitivity to Shock of Mixtures of Trinitrotoluene and Potassium Chlorate" by Alvaro Alberto and Marcello R. Liberalli, *Anais da Associacao Quimica do Brasil* III, No. 1, 37-39, 1944. Published in Brazil.)

TITANIUM IN STEEL

A STUDY was made on the possibility of improving the welding properties and toughness of the steel S.A.E. 4130 by addition of titanium. Composition range

of this steel is as follows: 0.25–0.35 percent carbon; 0.50–0.80 percent manganese; 0.50–0.80 percent chromium; 0.15–0.25 percent molybdenum. The average phosphorus content is 0.019 percent and the average sulphur content 0.026 percent. Aluminum is not added but is found in some samples. Some of the samples examined contain copper.

Addition of titanium results in improvement of the mechanical properties, especially if the quantity of manganese is increased somewhat. The influence of copper was also studied. Whereas steels of this type which are free of titanium or contain very small quantities of it have a martensitic structure, the titanium steels have the granular structure of perlite ferrite which, on increase in the quantity of manganese, acquires a sorbitic structure. A study made on welding of this type of steels showed that the addition of titanium increased the hardness of the weld.

Digest from "Effect of Titanium on the Properties of Chromium-Molybdenum Steel for Aeronautical Construction" by G. Comstock, *Stahl und Eisen*, 354, 61, 1941. (Published in Germany.)

ADSORPTION CAPACITY IN RELATION TO HYDROGEN AND METAL CATIONS

ADSORPTION capacity of such materials as permutite, zeolite, bentonite, clays and earths depends on the concentration of the hydrogen ions of an unbuffered solution; this capacity was therefore determined by washing the adsorbents with an unbuffered solution of a neutral salt. Dependence of the adsorption capacity on the concentration of the hydrogen and metal cations is expressed by the equation:

$$(1) \qquad S = \alpha + \beta\left(\mathrm{pH} - \frac{1}{n}\,\mathrm{pM}\right)$$

in which α and β are constants, n is the valence of the cation, and pM is the negative logarithm of the concentration of the cation. A comparison of equation (1) with Gortikov's empirical equation:

$$(2) \qquad S = \alpha + \beta\,\mathrm{pH} - \gamma\,\mathrm{pM}$$

shows that $\gamma = \frac{\beta}{n}$.

This result has been confirmed by the experiments of S. N. Ivanov for four cations (Na^+, K^+, Mg^{++}, Ba^{++}). The Ca^{++} ion is an exception.

Equation (1) can be represented in the form:

$$(3) \qquad S = \alpha_o + \beta_o \log a$$

in which a is the mean activity of the alkali. It follows from equation (3) that the adsorption of the cation from the alkali solution is subject to the equation:

$$(4) \qquad S = \alpha' + \beta_o \mathrm{pH}$$

whereas from the buffer solution:

$$(5) \qquad S = \alpha'' + \frac{n}{n+1}\,\beta_o\left(\mathrm{pH} - \frac{1}{n}\,\mathrm{pM}\right)$$

that is, the tangent of the angle of inclination of the function $S = f(\mathrm{pH})$ is different (for a different cation) on utilization of an alkali solution and a buffer solution (when pM is constant).

Digest from "Dependence of Adsorption Capacity on Concentration of Hydrogen and Metal Cations" by E. N. Gapon, *Zhurnal Obshchei Khimii* XIII, No. 6, 382-290, 1943. (Published in Russia.)

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

SOUTHERN NEIGHBOR

BRAZIL ON THE MARCH. *By Morris Llewellyn Cooke. Published by Whittlesey House, McGraw-Hill Book Co., New York, N. Y. 293 pages. Price $3.*

Reviewed by James A. Lee

WHEN submarine attacks on shipping plying between Brazil and the United States became so grave in 1942 as not only to influence seriously the conduct of the war against the axis powers, but also to affect drastically the internal economy of our southern neighbor, the American Technical Mission to Brazil was organized and sent down under the chairmanship of Morris Llewellyn Cooke. The mission's first objective was to assist Brazil find ways and means of supplying herself with the goods that were temporarily, at least, cut off. Its other objective was to lay the foundation for a long-range strengthening of that country's whole industrial economy.

The technical report of the mission has been distributed for the confidential use of the employees of both governments. This book is an effort to present to the interested layman an abstract of those portions of the findings which throw light on the development of present-day Brazil, the land, its agriculture, its economic setting, the country's resources in men and minerals, its fuel supplies, and power potential, and its transport problems.

The Brazilian chemical process industries are described at length in the chapter on manufactures. This material was based on the findings of the chemical engineer representative on the mission, Dr. Charles F. Bonilla, associate professor and acting head, Department of Chemical Engineering, Johns Hopkins University. (See "Chemical Industry Advancing in Brazil" by C. F. Bonilla, *Chem. & Met.*, March 1943, pp. 96-99).

The chemical industry in Brazil is largely a supplier of raw materials for other industries. It produces many of the chemicals required in textiles, pulp and paper, agriculture, mining, and metallurgy. The need for the products of the chemical industry is great, but is not so developed as Brazilian industry in general. Chemical production in that country is about 1 to 2 percent per capita of the American production; most other manufactures exceed this, ranging as high as 5 to 10 percent. The industry is hampered by many of the same things that hamper the local making of textiles and paper—the lack of transportation, the uneconomic small size of the plants, the habit of importing instead of manufacturing, and the lack of trained chemical engineers and chemists. Chemical companies in general have no research or development laboratories. It is believed, "In the future that Brazilian chemical industry can reach a better balanced internal economy, and an even better position as an exporter. Those raw materials of which she has an abundant supply can be processed within the country, and the products exported in exchange for import needs that cannot be met in Brazil."

RECENT BOOKS RECEIVED

Bernard Baruch. By Carter Field. McGraw-Hill (Wittlesey House). $3.

Dana's System of Mineralogy. 7th ed. Vol. I. By C. Palache, H. Berman & C. Frondel. Wiley. $10.

Ergebnisse der Vitamin und Hormonforschung. By Hellmut Bredereck u. Robert Mittag. Advance Scientific Publishers. $2.50

History of Color Photography. By J. S. Friedman. American Photographic Publishing. $10.

Plastic Molding and Plant Management. By D. A. Dearle. Chemical. $3.50.

Physical Foundations of Radiology. By O. Glasser, E. H. Quinby, L. S. Taylor & J. L. Weatherwax. Paul B. Hober. $5.

Ternary Systems. By G. Masing trans. by B. A. Rogers. Reinhold. $4.50.

Theory and Applications of Electron Tubes. 2nd ed. By H. J. Reich. McGraw-Hill. $5.

PRIMARILY DESCRIPTIVE

CHEMICAL MACHINERY. *By Emil Raymond Riegel. Published by Reinhold Publishing Corp., New York, N. Y. 583 pages. Price $5.*

Reviewed by J. R. Callaham

FIRST of its kind in this country, this descriptive text on chemical machinery is, as the sub-title describes it, "an elementary treatise on equipment for the process industries." The material is primarily descriptive and is supplemented with over 400 illustrations and diagrams. Dr. Riegel has made no attempt to delve into the theoretical or mathematical aspects of equipment design, nor has he tried to cover the chemical engineering angles of the unit operations. Instead, he presents in a readable manner the broad fundamental features of construction and operating technique. Wherever possible, approximate capacities and price ranges are included. The information, gathered principally from manufacturers' literature and from direct contact with equipment engineers, is of a practical nature; instances in which manufacturers' "over-statements" are reflected in the text are rare.

In collecting data for the book, Dr. Riegel limited himself to (1) equipment and devices which have general industrial application; highly specialized items are not included; (2) devices that can be purchased complete; home-made and improvised material is omitted; (3) equipment designed principally for large-scale operations; laboratory equipment is not admitted. The tabular classification charts for each group of related devices are interesting and serve as a "bird's-eye refresher" for those whose remembrance of certain fields of equipment has become hazy from infrequent use.

Engineers should not expect to find in this book detailed information on any "species" or even "family" of processing or handling equipment; recent books on pumps, conveyor systems, distilling and fractionating equipment, recording and controlling instruments, and similar topics should be consulted for such purposes. Riegel's "Chemical Machinery," on the other hand, will prove of most value to the student, the apprentice engineer in industry, operators and technicians in the chemical and process industries, the industrial engineer, and to technical personnel throughout industry who have occasion to use a general reference on equipment. To such persons, the present volume will be valuable in filling for the first time the gap between manufacturers' descriptive literature and the more specialized engineering textbooks and handbooks.

SLAP-DASH

PHYSICO-CHEMICAL METHODS. *Fourth edition. By Joseph Reilly and William Norman Rae. Published by D. Van Nostrand Co., New York, N. Y. 1,195 pages. Price $17.50.*

Reviewed by Donald F. Othmer

THERE have been some minor changes in the new edition of this widely used two-volume book but much of it is reprinted from the same plates as the third edition. The third edition was reviewed in *Chem. & Met.*, June 1940, p. 443, and there seems to be little to be added to that review. The total number of pages has been reduced and some material of a more elementary nature has been deleted. It is indicated that a supplementary volume may be issued in identical style in the near future.

As previously, the scope of the book, which is ostensibly a compendium of laboratory methods in physico-chemistry, trys to cover also, in a rather slap-dash fashion, much equipment of the unit operations of chemical engineering. Thus, plant design for high pressure work, industrial filters, trommels, grizzlies, evaporators, industrial dryers, etc., are taken in the authors' stride, along with vapor pressure measurements, microscopes, electronic tubes, accumulators, (eleven pages are given to this discussion of storage batteries themselves), etc. The section on commercial evaporators and dryers is neatly sandwiched between a section on laboratory stirrers and analytical balances. There seems no particular reason why any one thing in all of the related fields of chemistry, physics,

chemical physics, electricity, photography, chemical engineering, mechanical engineering, and those cognate thereto, may or may not be included, either in the form of a highly mathematical treatment of theory or an extremely general description of a manufacturing plant or method. Much of this is, of course, of an engineering rather than a laboratory nature; and is better treated in books so labeled. The background and manipulations of physical chemistry and physics for many of the engineering aspects are not present although they might well be expected in a book on physical chemical methods, while the authors find it easier to describe the engineering applications and equipment themselves in a rather cursory fashion.

The present edition has an index totalling six pages, as compared to the previous index of two pages (for a book of 1,200 pages, embracing thousands of individual items). There is thus only slight improvement in enabling the reader to find what he needs in this heterogeneous collection of material. This reviewer still believes (as in his reviews of the two previous editions) that much is collected in this book which is extremely valuable on the subject title. Often it is also very well presented, although the level of the writing varies considerably from section to section. While the authors in their preface indicate the considerable expansion of the field (or fields) which they encompass, and the need for a greater amount of space, it would seem that if the essential and important material relating to physico-chemical methods in this book was reorganized and the extraneous material so much better presented elsewhere was deleted, the book could be reduced very considerably in size. Nevertheless, it should be on the shelf of every practicing physical chemist and research chemical engineer.

GAS PROCEEDINGS

PROCEEDINGS OF AMERICAN GAS ASSOCIATION, 1943. *Published by American Gas Association, New York, N. Y. 435 pages. Price $3 to members; $7 to non-members.*

THIS is the customary printing of the proceedings of the annual convention of American Gas Association held in October 1943. It represents the only recording of the technical proceedings available for library reference purposes. It includes also the text of many articles presented in complete form at divisional meetings of the Association that were presented only by title or abstract at the annual convention.

READABLE ORGANIC

ORGANIC CHEMISTRY. *By L. F. Fieser and Mary Fieser. Published by D. C. Heath and Co., Boston, Mass. 1091 pages. Price $8 (trade edition), $6 (college edition).*

Reviewed by F. C. Nachod

THE GREAT Wöhler referred to organic chemistry as "a dreadful endless jungle into which one is afraid to enter for there seems no way to lead out of it." Many texts were written since his time and the aim has been to clear a network of paths through the forest. A great number of

textbooks have stressed the systematic and classifying side of this field to such a degree that they make for poor reading, and only a few truly readable texts exist.

This book by Fieser and Fieser is an exception. While it gives a clear and concise development of the fundamental chemistry of the various classes of compounds, it does it in such an easy way that the reader is kept spellbound.

A special feature is the inclusion of a number of chapters dealing with applications of organic chemistry to industry, medicine, and biology. So, just to name some examples, the reader finds chapters on petroleum, on rubber, on synthetic fibers, resins and plastics, on chemotherapy, and on microbiological processes.

Specific references could not be included for lack of space, but this does not detract from the value of the book, but rather streamlines it. Both as an introduction and as a refresher, the book can be wholeheartedly recommended.

OLEAGINOUS PRODUCTS

VEGETABLE FATS AND OILS. *Second edition. By George S. Jamieson. Published by Reinhold Publishing Corp., New York, N. Y. 508 pages. Price $6.75.*

IN THE second edition of his ACS Monograph 58, Dr. Jamieson has preserved the arrangement of the first—fats and oils are divided into three classes: non-drying, semi-drying and drying. Descriptive matter has been rewritten wherever necessary for modernization of the material, the author states. And additions have been made in the chapter on methods and the appendix has new data on quantity and character of oil in seeds from ornamental trees and plants.

Three chapters, one for each of the three classes of oils, constitute the major portion of the book. The oils in each class are arranged alphabetically and with each are presented the data which make this book a small specialized encyclopedia. The amount of information supplied depends, of course, on industrial importance as well as on what was available to the author. Derivation, botanical data, producing areas, characteristics, composition, properties and uses are given for most oils. Adulterants, production statistics, tests and references are included with many of the more important entries.

Considerable information on saturated and unsaturated acids is given in a chapter on fatty acids. Test methods comprise the concluding chapter.

ELEMENTARY QUANT

QUANTITATIVE ANALYSIS. *Second edition. By Harold S. Booth and Vivian R. Damerell. Published by McGraw-Hill Book Co., New York, N. Y. 303 pages. Price $2.50.*

IN REVISING any textbook, the opportunity is presented to the author (or authors, as in this case) to profit by further personal experience as well as by suggestions and criticisms from students and teachers. Drs. Booth and Damerell have so done: ". . . the text has been thoroughly reexamined . . . certain passages clarified or expanded, and additional self-examination questions added . . . introduced

problems in gravimetric and volumetric analysis . . ." "Seven additional determinations . . . have been added." The general scheme of the book remains the same. Theory is secondary to laboratory directions. Chapters are terse and brief, averaging only seven pages each. The book can be used for one- or two-term courses and, with accompanying classroom time, will give a satisfactory groundwork in quantitative analysis.

FERROUS METALLURGY, Vol. III

METALLOGRAPHY AND HEAT TREATMENT OF STEEL. *Second edition. By E. J. Teichert. Published by McGraw-Hill Book Co., New York, N. Y. 577 pages. Price $5.*

PROF. TEICHERT has given to this final volume in his series a full measure of those attributes which denote excellence in a textbook. The facts are stated and illustrated clearly. The scope is sufficiently extensive yet discreetly limited to fundamentals. Subjects are introduced in a logical and effective order. Further study is encouraged by frequent reference to other sources of information.

As far as subject matter goes, the text covers microscopy (including photographic techniques); testing (with X-ray, gamma-ray, magnetic, and physical tests); the iron-carbon diagram (well introduced and discussed); mechanical treatment (effects upon structure and properties of steel); heat treatment of plain carbon steel (over 100 pages covering the purpose, the methods, and the effects of heat treatment). Other chapters discuss the treatment of steel castings and cast iron, precipitation hardening, grain size, case-hardening, alloy steels and the individual effects of alloying elements, S.A.E. steels, factors affecting the selection of steels, and finally, some special alloys for tool steels and for corrosion-, heat-, and abrasion-resistance.

TOOL STEEL

TOOL STEELS. *By J. P. Gill, R. S. Rose, G. A. Roberts, H. G. Johnstin and R. B. George. Published by American Society for Metals, Cleveland, Ohio. 577 pages. Price $6.*

IN A 530-page digest, the authors have skillfully condensed and correlated the great, unwieldy mass of information published over a period of years and dealing with the manufacture, testing, classification, heat treatment, properties, and proper selection of the more commonly used tool steels. While the text deals chiefly in fundamentals and general principles involved in using the various steels, there is a wealth of specific information presented in some 300 charts and graphs. The whole is well indexed and an extensive bibliography is included.

RECENT BOOKS & PAMPHLETS

The Storage of Isobutylene. Research Bulletin No. 7,401-B, published by Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. 37 pages. Physical and chemical properties, container materials, protective coatings and proper storage conditions.

Physical Properties Pertinent to the Storage

of a Number of Commercially Important Liquids and Gases. Research Bulletin No. 7.427-B, published by Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. 24 pages. Physical properties of 91 substances. Specific heat charts for 32 of the chemicals are included.

Electronics; Today and Tomorrow. By John Mills. Published by D. Van Nostrand Co., New York 3, N. Y. 178 pages. Price $2.25. From electrons to cyclotrons. Sixteen chapters that read like a series of lectures for popular consumption.

A Plan to Help You Employ Disabled Veterans and Other Handicapped Persons Productively and Safely. Distributed by American Mutual Alliance, 919 N. Michigan Ave., Chicago 11, Ill. 22 pages. Five steps in connection with employing handicapped persons.

Pulp and Paper Manufacture; Bibliography and United States Patents, 1943. Compiled by C. J. West. Published by Technical Association of the Pulp and Paper Industry, 123 E. 42nd St., New York, N. Y. 223 pages. A listing of articles and patents concerning pulp and paper, manufacture and use.

Thermodynamic Properties of Carbides of Chromium. By K. K. Kelley. Bureau of Mines Technical Publication 662, available from Superintendent of Documents, Washington 25, D. C. 43 pages. Price 10 cents. Describes preparation of carbides of chromium and gives observations of the general properties of the carbides.

Protecting Plant Manpower Through the Control of Air Contaminants. U. S. Department of Labor, Technical Bulletin No. 14. Available from Superintendent of Documents, Washington 25, D. C. 28 pages. Price 10 cents. Three articles on locating and eliminating hazards and protecting workers against temporary and emergency exposures.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publication noted in this list always give the complete title and the issuing office. Remittance should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the Bureau responsible for its issue.

An Apparatus for Differential Thermal Analysis. By Louis H. Berkelhamer. Bureau of Mines. Report of Investigations, R. I. 3762. Mimeographed.

Differential Thermal Analysis of Quartz. By Louis H. Berkelhamer. Bureau of Mines. Report of Investigations, R. I. 3763. Mimeographed.

Applications of Thermal Analysis to Clays and Aluminous Minerals. By Sidney Speil. Bureau of Mines. Report of Investigations, R. I. 3764. Mimeographed.

Report No. FT 900. Total value of imports from and exports to each of the Latin American Republics including strategic, critical and military commodities, no commodity breakdown shown, available six months after the period covered. Monthly press release, starting with figures for July 1943. No charge. Available from Bureau of the Census, Washington, D. C

Comparison of Fine-Series, Square-Mesh-Wire Test Sieves of Different Countries. By R. E. Brewer. Bureau of Mines. Report of Investigations, R. I. 3766. Mimeographed.

Salvage of Coal from Mine Refuse in the Pittsburgh District. By Thomas Fraser, J. A. Kelley, and H. F. Graham. Bureau of Mines. Report of Investigations, R. I. 3768. Mimeographed.

Precision Jigging as a Substitute for Labora-

tory Sink-Float. By G. Dale Coe and Will H. Coghill. Bureau of Mines. Report of Investigations, R. I. 3769. Mimeographed.

The Composition and Properties of Molding Sands. Part 1. The Nature of the A. F. A. Clay Fraction Removed from Natural Molding Sands. By Louis H. Berkelhamer. Bureau of Mines. Report of Investigations, R. I. 3774. Mimeographed.

History of Water-Flooding of Oil Sands in Kansas. By Peter Grandone. Bureau of Mines Report of Investigations, R. I. 3761. Mimeographed.

Ore-Testing Studies on Gold and Gold-Silver Deposits. By J. A. Woolf and A. P. Towne. Bureau of Mines Report of Investigations, R. I. 3765. Mimeographed.

A Method for Surveying Drill Holes by Oriented Drill Rods. Bureau of Mines Report of Investigations, R. I. 3773. Mimeographed.

Analyses of Virginia Coals. By J. B. Eby and M. R. Campbell. Bureau of Mines Technical Paper 656. Price 15 cents.

A Study of Summer Air-Conditioning With Water Sprays to Prevent Roof Falls at the Beech Bottom Coal Mines, West Virginia. Bureau of Mines. Report of Investigations, R. I. 3775. Mimeographed.

Energies and Equilibria in the Decomposition of Nitrates of Maganese, Magnesium, Calcium, Barium, and Aluminum and Reactions of Nitrogen Peroxide. By K. K. Kelley. Bureau of Mines. Report of Investigations, R. I. 3776. Mimeographed.

Wartime Application of Air-Gas Injection and Oil-Well Reconditioning in the Appalachian Region. By Sam S. Taylor. Bureau of Mines. Report of Investigations, R. I. 3777. Mimeographed.

A Vibrating Screen Surface for the Removal of Flat and Elongated Pieces from Crushed Stone. By Lloyd H. Banning and Frank D. Lamb. Bureau of Mines. Report of Investigations, R. I. 3781. Mimeographed.

Mining and Milling Operations of Rutile Mine of the Titanium Alloy Co. of Arkansas Hot Spring County, Ark. By Felix A. Vogel, Jr. Bureau of Mines. Information Circular, I. C. 7293. Mimeographed.

Review of the Mineral Industries in 1943. By E. W. Pehrson. Bureau of Mines. MMS No. 1233. Mimeographed.

Distribution of Byproduct and Beehive Coke in the United States, 1943. Bureau of Mines, M.M.S. No. 1232. Mimeographed.

Procedure for Applying for Tests Made on Explosives (Including Sheathed Explosives) and Blasting Devices by the Bureau of Mines. Bureau of Mines. Schedule 1E. Price 5 cents.

Mineral Industry of Alaska in 1941 and 1942. By P. S. Smith. Geological Survey. Bulletin 943-A. Price 10 cents.

Geology and Manganese Deposits of Guisa-Los Negros Area, Oriente Province, Cuba. By W. P. Woodring and S. N. Davies. Geological Survey. Bulletin 935-G. Price 45 cents.

Manganese Deposits of the Flat Top and Round Mountain Districts, Bland and Giles Counties, Virginia. By Harry S. Ladd and Frank W. Stead. Geological Survey. Bulletin 940-H. Price 75 cents.

Geology of the Grey Eagle and Some Nearby Chromite Deposits in Glenn County, California. By G. A. Rynearson and F. G. Wells. Geological Survey. Bulletin 945-A. Price 50 cents.

Chromite Deposits Near San Luis Obispo, San Luis Obispo County, California. By Clay T. Smith and Allan B. Griggs. Geological Survey. Bulletin 945-B. Price 60 cents.

Geology of Dam Sites on the Upper Tributaries of the Columbia River in Idaho and Montana. Part 2. Hungry Horse Dam and Reservoir Site South Fork Flathead River, Flathead, Montana. By C. E. Erdmann, with a Section on Geophysical Investigations by B. E. Jones. Geological Survey Water-Supply Paper 866-B. Price 40 cents.

Water Levels and Artesian Pressure in Observation Wells in the United States in 1942. Part 2. Southeastern States. By O. E. Meinzer, L. K. Wenzel and others. Geological Survey. Water-Supply Paper 945. Price 25 cents.

Ground-Water Resources of the Houston District, Texas. By W. N. White, N. A.

Rose, and W. F. Guyton. Geological Survey. Water-Supply Paper 889-C. Price 35 cents.

Geology and Ground-Water Resources of the Big Spring Area, Texas. By Penn Livingston and Robert R. Bennett. Geological Survey. Water-Supply Paper 913. Price 50 cents.

Texas Floods of 1938 and 1939. By Seth D. Breeding and Tate Dalrymple. Geological Survey. Water-Supply Paper 914. Price 25 cents.

Survey of University Business Research Projects 1943-44. (A compilation of the studies in business and economic research recently completed or in process in Universities, Colleges, and Research Institutions.) Bureau of Foreign and Domestic Commerce.

Air Cargo Potentials between the U. S. and Argentina. Bureau of Foreign and Domestic Commerce. Mimeographed.

Air Cargo Potentials between the United States and Brazil. Bureau of Foreign and Domestic Commerce. Mimeographed.

Air Cargo Potentials between the United States and Peru. Bureau of Foreign and Domestic Commerce. Mimeographed.

Salad Dressing, Mayonnaise and Related Products—1943. By Dorothy Bayles and Lilly I. Nikula. Bureau of Foreign and Domestic Commerce. Industrial Series No. 12. Mimeographed.

Pulp and Paper Trade Statistics of the Other American Republics 1938-1941. By B. M. Frost and E. Sukmanowsky. Bureau of Foreign and Domestic Commerce. Economic Series 35. Mimeographed.

Porcelain-Enameled Steel Utensils (Second Edition). Bureau of Standards. Commercial Standard, CS100-44. Price 5 cents.

Dial Indicators (for Linear Measurements). Bureau of Standards. Commercial Standard (Emergency) CS(E)119-45. Price 5 cents.

Thermal Insulation of Dwelling Houses. Bureau of Standards. Letter Circular, LC-759. Mimeographed.

Finishes for Concrete Floors. Bureau of Standards. Letter Circular, LC-758. Mimeographed.

Information on Ultraviolet Transparency of Window Materials and Fabrics. Bureau of Standards. Letter Circular, LC-760. Mimeographed.

Solders and Soldering. Bureau of Standards. Letter Circular, LC-761. Mimeographed.

Rubber. U. S. Tariff Commission. War Changes in Industry Series Report No. 6.

Summary Report on Production and Sales of Synthetic Organic Chemicals in the United States, 1943. U. S. Tariff Commission. Mimeographed.

Federal Statistical Directory. Eighth Edition, April 1944. Bureau of the Budget. Price 25 cents.

Report of the Federal Trade Commission on Distribution Methods and Costs. Part IV. Petroleum Products, Automobiles, Rubber Tires and Tubes, Electrical Household Appliances, and Agricultural Implements. Federal Trade Commission. Price 25 cents.

Freight Commodity Statistics, Class I Steam Railways in the United States Year ended December 31, 1943. Interstate Commerce Commission. Statement No. 44100. Price $1.

The Industrial Nurse and The Woman Worker. By Jennie Mohr. Department of Labor, Women's Bureau, Special Bulletin No. 19. Price 10 cents.

Directory of Commodities and Services. Office of Price Administration. Price $1 (including six monthly supplements).

Federal Specifications. New or revised specifications which made up Federal Standard Stock Catalog have been issued on the following items: Nickel, anodes QQ-N-265. Asphalt, emulsion (for) road work SS-A-674a. Indian-red and bright-red (iron-oxide); dry (paint-pigments) TT-I-511a. Mineral-red (iron-oxide), natural; dry (paint-pigments) TT-M-381. Pigments-in-oil, paint-colors TT-P-381. Sienna, burnt and raw; dry (paint-pigment) TT-S-346. Umber, burnt and raw; dry (paint-pigment) TT-U-481. Carbon-black, dry (paint-pigment) TT-C-120. Metallic-brown; dry (paint-pigment) TT-M-251. Paint, varnish, lacquer, and related materials; general specification for sampling and test methods TT-P-141a. Venetian-red; dry (paint-pigment) TT-V-226. Price 5 cents each.

MANUFACTURERS' LATEST PUBLICATONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Air Scrubber. J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.—4-page folder listing advantages of the Ross Air Scrubber. Illustrations include sectionalized view of apparatus. Back cover has list of standard Ross Scrubbers, with comparison of capacity, height, weight, action, etc.

Chilling Machines & Exchangers. Worthington Pump & Machinery Corp., Air Conditioning & Refrigeration Division, Harrison, N. J.—10-page bulletin discussing double-pipe, scraped-surface chilling machines and exchangers. Gives brief history and description of chilling process. Also has 1-page foldout with diagrammatic drawings of inclined direct-expansion chilling machine and horizontal double-pipe exchanger. Illustrated. Bulletin No. C-1100-B15.

Chlorinating Agents. Hooker Electrochemical Co., Niagara Falls, N. Y.—8-page bulletin giving technical data on chlorine, sulphur chlorides, mono- and di-, sulphuryl chloride, thionyl chloride, hydrogen chloride, and phosgene (carbonyl chloride). Describes and compares performance; has one table containing physical data. Technical bulletin No. 328 A.

Controllers. The Bristol Co., Waterbury 91, Conn.—8-page bulletin describing a new line of air-operated controllers known as the Model 93 series. Gives detailed information on how these instruments control temperature, pressure, vacuum, liquid level, humidity, and flow. Bulletin No. A115.

Diesel Engines. Worthington Pump & Machinery Corp., Harrison, N. J.—8-page bulletin giving data on vertical four-cycle and direct-injection Worthington BB type engines. Includes numbered diagram with advantages; also specifications and dimensions. Illustrated. Bulletin No. S-500-B35A.

Electronic Relay. General Electric Co., Schenectady, N. Y.—8-page folder giving data on an electronic relay. Includes description, operation, applications and advantages. Contains diagrams and practical photographs. Bulletin No. CR 7511-A.

Electronic Controllers. The Bristol Co., Waterbury 91, Conn.—6-page folder giving data on Bristol Free-Vane electronic controllers for temperature, pressure, liquid level, humidity and time. Photographs and brief descriptions explain types, performance, advantages. Bulletin No. DM009.

Gloves. Surety Rubber Co., Carrollton, Ohio—Circular chart selector, comparing Sureseal synthetic rubber gloves with oil-resistant synthetic gloves and natural rubber gloves, when in contact with industrial chemicals.

Heat Protection. Metallizing Engineering Co., Inc. 38-14 30th St., Long Island 1, N. Y.—Folder listing and explaining three processes, known as Metcolizing, which may be applied to iron and steel to prevent corrosion at high temperatures. Process 11 shields against corrosive action of gases at temperatures up to 1,600 deg. F. Process 33 protects against action of corrosive gases where temperatures range from 1,600 to 1,800 deg. F. Process 45 provides maximum protection, withstanding temperatures up to 1,800 deg. F. and higher. Bulletin No. 45.

Industrial Relations. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.—32-page pocket-size brochure containing address by Charles S. Redding, President of Leeds & Northrup Co., on subject of employer-employee relations. Introduction by C. Tolan, Jr., President of the Metal Manufacturers' Association of Philadelphia. Discusses the executive setup, the ownership setup, the bonus plan, and the general industrial relations setup.

Industrial Rubber. B. F. Goodrich Co., 490 South Main St., Akron, Ohio—12-page general booklet on industrial rubber products of this

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

ENLARGED MUNITIONS PROGRAM CURTAILS CHEMICAL SUPPLY FOR INDUSTRIAL USE

THE *Chem. & Met.* index for industrial consumption of chemicals fell off rather sharply in September but this was due more to a reduction in the number of working days than to any material change in the daily rate of operation and preliminary reports regarding activities in October indicate a substantial gain over the September totals. Last year the index for September was 177.02, for October 181.94, for November 181.15, and for December 179.45, with the index for the year standing at 177.02. From present indications the index for 1944 will be in the neighborhood of 183 which will represent the peak year for the industry although the increase over 1943 will be less than 4 percent.

The course of total industrial production for the year has been downward according to the indexes of the Federal Reserve Board. For January the index stood at 240 and for September it was reported at 234. On the same authority, manufacturing output dropped from 259 in January to 251 in September. For chemicals the Board issues two index numbers, one under the classification of chemicals which includes different related products and one for industrial chemicals. The more inclusive index was 362 in January and has dropped steadily each month since then with the September number at 306. On the other hand the index for industrial chemicals which opened the year at 405 rose to a high of 412 in June and then turned downward to reach a preliminary figure of 399 for September. For the first nine months of this year, the index for production of industrial chemicals is approximately 407 as compared with 357 for the like period of 1943. This indicated gain of 14 percent for the current year is larger than the percentage gain recorded by the *Chem. & Met.* index for chemical consumption, which is logical since a part of industrial chemical production is consumed directly in war industries.

Requirements for chemicals have moved in both directions. In some cases, reductions in outputs of end products have taken place and this has eased the position of a varied line of raw materials. However, there still is a shortage of many chemicals with military needs taking up the greater part of offerings and leaving an inadequate supply for civilian purposes. Among the chemicals in limited supply is anhydrous hydrofluoric acid. Production in the first half of this year reached a total of approximately 10,800 tons which was sufficient to meet essential requirements. In the third quarter, military demands rose to 7,000 tons and productive capacities were strained to turn out 6,400 tons. For the final quarter, requirements are estimated at about 8,500 tons and in order to raise the output, authorization has been given to the General Chemical Co. to build a plant at Baton Rouge, La., with an annual capacity of 6,000 tons. The Nyotex Chemical Co., Houston, Texas, also has been given permission to expand its plant by about 3,900 tons. These new outputs are expected to be in operation by next February when quarterly production should reach 9,500 tons or enough for all military and essential civilian requirements.

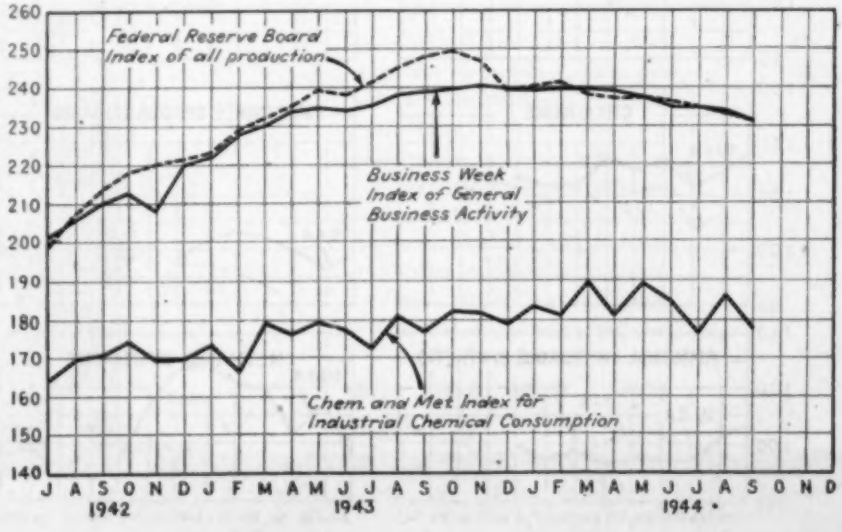
While there is a possibility that the munitions program may be cut back in the near future and thus relieve the stringency in some chemicals which are important in that line of manufacture, the program at present is being speeded up and calls for an even larger consumption of materials in the months ahead. This situation has been given considerable publicity for some time because the diversion of sulphuric acid and ammonia from the fertilizer industry has interfered with the food program. As in the case of hydrofluoric acid, the shortage in sulphuric acid has brought forth recommendations for the establishment of new capacities. Plans for three new plants have been submitted. The projects are: Monsanto Chemical Co., East St. Louis, Ill., to produce from 70,000 to 75,000 tons; National Lead Co., East St. Louis, to produce an equal amount; and General Chemical Co., Newell, Pa., to produce oleum to balance the over-all shortage.

The increased call for ammonia for manufacturing munitions also has been felt in cutting down production of formaldehyde. Formerly the small order allotment for formaldehyde was 10,000 lb. of 37 percent solution a month. This has now been reduced to 1,500 lb. a month and the monthly small order maximum for paraformaldehyde has been cut from 3,000 lb. to 500 lb. Production of synthetic methanol also has dropped sharply.

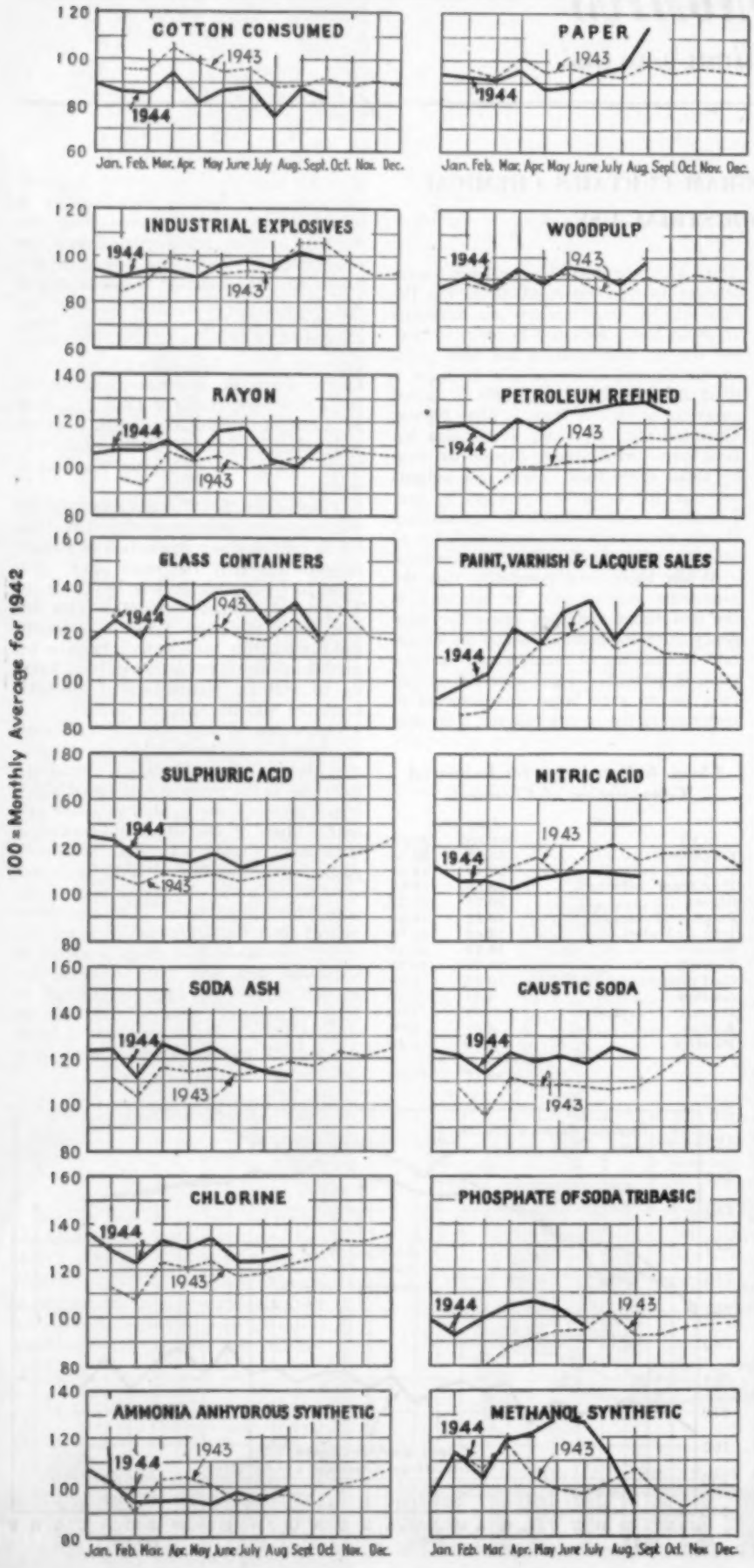
Operations at vegetable oil mills were broadened in September but the increase over the preceding month was almost entirely due to the crush of cottonseed which began to reach the market in larger volume. Most of the other oils made an unfavorable showing. Crushers of linseed, particularly along the Atlantic seaboard, are working under the handicap of uncertain arrivals of flaxseed. The movement of seed from the Argentine has practically ceased and while fairly large amounts of Canadian seed have been received, the over-all supply has been insufficient to keep all mills in operation and with the close of water transportation near at hand, the outlook for the next few months is far from promising.

Chem. & Met. Index for Industrial Consumption of Chemicals

	Aug. revised	Sept.
Fertilizers	38.55	36.50
Pulp and paper	19.40	18.20
Petroleum refining	18.68	18.15
Glass	20.75	18.77
Paint and varnish	19.12	18.85
Iron and steel	13.46	12.89
Rayon	16.73	16.79
Textiles	10.70	10.33
Coal products	10.35	9.98
Leather	4.30	4.50
Industrial explosives	5.83	5.68
Rubber	3.00	3.00
Plastics	5.30	5.20
	186.17	178.84



PRODUCTION AND CONSUMPTION TRENDS



While the Regional Shippers' Advisory Boards forecast an increase of but 0.9 percent in carloadings for the final quarter of this year as compared with the last three months of last year, their average is found to contain some rather sharp declines in the movement of manufactured products. For fertilizer an increase of 4.2 percent is estimated, for paper, paperboard, and prepared roofing the increase is placed at 1.5 percent, and for manufactures and miscellaneous, the increase is expected to reach 9.5 percent. No estimate is given for chemicals but the position of the most important consuming industries is such as to forecast a slight improvement over the totals of last year. In some cases however, military requirements are cutting into civilian supplies in two ways.

In the first place, military needs are given the preference in the allotment of chemicals and other raw materials and in some instances, a large part of finished production is reserved for the armed forces. For instance, the recent scarcity of matches is attributed not only to the fact that total production is running about 15 percent below the 1943 level but also to the fact that a large part of the output does not go to civilians. Recently large orders for laundry soap for military or Lend-Lease distribution has raised fears that this product may become scarce in the open market.

The attempt to hold pulpwood supplies up to a point where paper mills might operate at a satisfactory level ran into further difficulties last month when the movement of wood from Canada was threatened by a scarcity of railroad cars for transportation. A total of 450,000 cords of pulpwood was expected to be shipped from Canada in the final quarter of this year. Whether this will be realized depends on the solution of this transportation problem. Incidentally the hope of obtaining pulp from Sweden has been lessened by reports that such surplus stocks will be sent to other countries which are badly in need of supplies.

In the fertilizer field, there has not been enough sulphate of potash to meet all demands. This has said to have forced wider acceptance of muriate but growers of tobacco are interested in the announcement that fertilizer manufacturers may convert a part of their allotted muriate into sulphate. Also in order to increase the supply of sulphate, the plant of the Rubber Reserve Co. at Louisville will substitute potassium chloride for sodium chloride in its production of hydrochloric acid and thus add about 3,000 tons to the sulphate supply. The latest survey shows that about 725,000 tons of K_2O will make up the potash supply for next season's crops.

There was a sharp drop in glass container output in September but stocks are not unduly large and it is not anticipated that the industry will curtail to any great extent until such time as the container situation in general becomes more normal and shippers are able to weigh their wartime experience and express their preference in selecting containers.

U. S. Production, Consumption and Stocks of Synthetic Organic Chemicals, May-August, 1944*

Item	May	June	July	August
Acetanilide (technical and U. S. P.):				
Production	367,342	†	177,754	211,486
Consumption	209,126	90,461	85,020	95,896
Stocks	802,667	834,008	741,269	592,477
Acetic acid (synthetic):[3]				
Production	25,185,075	22,994,169	21,870,652	23,355,074
Consumption	18,003,498	17,636,695	16,052,392	16,065,397
Stocks	9,438,528	7,954,401	6,430,917	6,280,788
Acetic acid:[9]				
Production	3,478,309	3,308,389	3,101,849	3,176,373
Consumption	†	†	12,396	20,229
Stocks	1,292,042	1,201,607	1,189,695	1,313,666
Acetic anhydride:[3]				
Production	41,648,309	40,048,345	Published	Published
Consumption	32,519,325	30,235,442	quarterly	quarterly
Stocks	12,025,587	10,867,460		
Acetylsalicylic acid (Aspirin):				
Production	819,287	° 744,251	691,290	737,600
Consumption	.....	†	†	†
Stocks	960,934	1,012,263	971,657	915,912
n-Butyl acetate:				
Production	5,757,102	6,124,667	5,337,323	5,804,876
Consumption	164,011	196,128	†	†
Stocks	3,911,193	3,050,241	3,055,406	3,421,471
Creosote oil, tar distillers (gal.):[3]				
Production	10,408,347	10,156,706	8,313,012	9,008,557
Consumption	882,897	1,039,091	835,284	604,203
Stocks	26,632,177	24,840,244	22,735,041	17,809,732
Creosote oil, byproduct (gal.):[3]				
Production	3,590,622	3,568,836	3,448,501	3,434,307
Consumption	74,816	28,549	47,519	32,925
Stocks	1,674,474	1,515,015	1,308,373	1,009,876
Cresols, meta-para:[3]				
Production	690,558	531,608	435,372	526,596
Stocks	458,644	153,923	150,949	640,670
*Cresols, ortho-meta-para:[3]				
Production	861,868	866,565	808,773	1,154,520
Consumption	.....	†	†	.....
Stocks	†	†	†	†
Cresylic acid, crude:				
Production	2,010,930	1,951,678	2,274,014	2,489,407
Stocks	1,491,916	1,079,905	1,457,560	1,731,725
Cresylic acid, refined:[3]				
Production	3,782,406	3,257,439	3,552,622	3,432,460
Consumption	†	†	†	†
Stocks	2,016,307	2,229,757	5,858,702	2,720,144
Diethyl ether (all grades):				
Production	5,479,999	4,619,999	4,988,529	5,088,509
Consumption	495,282	353,610	757,005	236,647
Stocks	1,317,271	1,895,131	2 039,003	2,019,774
Ethyl acetate (85 percent):				
Production	8,213,741	8,772,412	7,771,456	9,074,118
Consumption	1,344,163	1,135,158	1,409,871	1,668,727
Stocks	5,397,266	6,570,952	6,135,466	6,765,945

Item	May	June	July	August
Lactic acid (edible):				
Production	368,974	[4]	264,254	457,441
Stocks	371,275	267,098	298,108	75,612
Lactic acid (technical):				
Production	238,526	374,340	315,535	351,524
Consumption	21,584	15,359	14,579	17,906
Stocks	142,386	173,900	286,435	259,632
Methyl chloride (all grades):				
Production	1,936,596	2,001,151	2,053,749	2,138,819
Stocks	871,972	709,295	613,422	383,574
Naphthalene, byproduct:[5]				
Production	9,094,765	8,230,393	8,239,513	8,340,395
Consumption	[4]	[4]	[4]	[4]
Stocks	2,802,080	2,343,626	2,466,724	2,663,410
Naphthalene, tar distillers:[5]				
Production	15,368,562	15,752,696	15,741,231	15,540,507
Consumption	[4]	[4]	[4]	[4]
Stocks	9,728,602	8,790,914	7,166,598	6,987,332
Naphthalene, refined (79° C. and over):				
Production	7,076,885	7,294,741	6,350,584	6,122,595
Consumption	4,575,096	4,738,623	4,767,323	4,712,470
Stocks	1,785,706	1,356,642	1,454,378	1,971,951
Oxalic acid (technical):				
Production	1,550,038	1,584,652	1,354,572	1,337,471
Consumption	[4]	[4]	[4]	[4]
Stocks	351,875	437,740	414,764	482,974
Phenobarbital and sodium salts:				
Production	24,683	20,171	12,288	11,924
Stocks	51,342	56,424	49,813	45,359
Phthalic anhydride:				
Production	10,713,572	9,664,363	10,643,510	10,600,197
Consumption	2,441,743	3,138,638	2,934,479	4,416,321
Stocks	2,403,789	2,909,286	2,954,420	3,243,728
Riboflavin (for human use):				
Production	9,039	7,629	5,836	[4]
Consumption	[4]	[4]	[4]	1,049
Stocks	39,228	40,051	41,937	39,415
Sulfa drugs (total):[10]				
Production	336,835	234,014	246,450	220,543
Consumption	38,781	[4]	21,879	51,118
Stocks	1,650,100	1,624,284	1,497,830	1,353,723

[1] All data in pounds except as noted. Statistics collected and compiled by U. S Tariff Commission and issued jointly with the War Production Board. For Jan.-April statistics see *Chem. & Met.*, July 1944, p. 206. Production: consumed in producing plants or sold. Consumption: in producing plants only (where no quantities are given data are confidential because publication would reveal operations of individual companies). Stocks: as of the last day of the month. [3] Statistics of production of recovered acetic acid are confidential and therefore are not included. [2] Natural and from calcium acetate. Collected and compiled by Bureau of the Census. [5] Includes anhydride from acetic acid by vapor phase process. [4] Confidential. [6] Includes statistics reported by distillers of purchased tar only. [8] Statistics represent oil produced by byproduct coke-oven operators. Collected and compiled by Bureau of Mines. [7] Includes statistics reported to Bureau of Mines by byproduct coke-oven operators in addition to those reported to the Tariff Commission by tar distillers. [9] Less than 79 deg. C. Statistics collected by Bureau of Mines represent naphthalene produced for sale by byproduct coke-oven operators. The grades melting at less than 74, 74-76, and 76 to less than 79 deg. C. represent production for sale. [9] Less than 79 deg. C. These statistics are for three grades of crude naphthalene: solidifying at less than 74 produced for sale only; 74-76; and more than 76 but less than 79 deg. C. As there is some conversion between grades, the data include some duplication. [10] Production, consumption and stocks of acetylsulfathiazole are included.

CHEM. & MET.
Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	**108.81**
Last month	109.40
November, 1943	109.54
November, 1942	108.94

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell fob works, quotations are so designated. Prices are corrected to November 13.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb.	$0.07 –
Acid, acetic, 28%, bbl., 100 lb.	3.38 – $3.63
Boric, bbl., ton	109.00 – 113.00
Citric, kegs, lb.	.20 – .23
Formic, cbys, lb.	.10½ – .11
Hydrofluoric, 30%, drums, lb.	.08 – .085
Lactic, 44%, tech., light, bbl., lb.	.073 – .075
Muriatic, 18°, tanks, 100 lb.	1.05 –
Nitric, 36°, carboys, lb.	.05 – .05½
Oleum, tanks, wks., ton	18.50 – 20.00
Oxalic, crystals, bbl., lb.	.11½ – .12½
Phosphoric tech., tanks, lb.	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb.	.70½ –
Alcohol, amyl	–
From pentane, tanks, lb.	.131 –
Alcohol, butyl, tanks, lb.	.10½ – .18½
Alcohol, ethyl, denatured, 190 proof	–
No. 1 special, tanks, gal., wks.	.50 –
Alum, ammonia, lump., bbl., lb.	.04½ –
Aluminum, sulphate, com. bags, 100 lb.	1.15 – 1.40
Ammonia, anhydrous, cyl., lb.	.14½ –
tanks, ton	59.00 – 69.00
Ammonium carbonate, powd. tech., casks, lb.	.09½ – .12
Sulphate, wks., ton	28.20 –
Amyl acetate, tech., from pentane, tanks, lb.	.145 –
Aqua ammonia, 26°, drums, lb.	.02½ – .03
tanks, ton	65.00 –
Arsenic, white, powd., bbl., lb.	.04 – .04½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, cask, lb.	.09½ – .11
Blanc fix, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb.	2.50 – 3.00
Borax, gran., bags, ton	45.00 –
Calcium acetate, bags	3.00 –
Arsenate, dr. lb.	.07 – .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	18.50 – 25.00
Carbon bisulphide, drums, lb.	.05 – .05½
Tetrachloride drums, gal.	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb.	1.75 – 2.00
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb.	.19½ – .20
Sulphate, bbl., 100 lb.	5.00 – 5.50
Cream of tartar, bbl., lb.	.57 –
Diethylene glycol, dr., lb.	.14½ – .15½
Epsom salt, dom., tech., bbl., 100 lb.	1.90 – 2.00
Ethyl acetate, tanks, lb.	.11½ –
Formaldehyde, 40%, tanks, lb.	.032 –
Furfural, tanks, lb.	.09½ –
Glaubers salt, bags, 100 lb.	1.05 – 1.10
Glycerine, c.p., drums, extra, lb.	.15½ – .11
Lead:	
White, basic carbonate, dry casks, lb.	.08½ –
Red, dry, sck., lb.	.09½ –
Lead acetate, white crys., bbl., lb.	.12 – .13
Lead acetate, powd., bag, lb.	.11 – .12
Lithopone, bags, lb.	.04 – .04½
Magnesium carb., tech., bags, lb.	.06½ – .06½
Methanol, 95%, tanks, gal.	.58 –
Synthetic, tanks, gal.	.24 –
Phosphorus, yellow, cases, lb.	.23 – .25
Potassium bichromate, casks, lb.	.09½ – .10
Chlorate, powd., lb.	.09½ – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½
Muriate, 60% bags, unit	.53½ –
Nitrate, bbl., lb.	.05½ – .06
Permanganate, drums, lb.	.19½ – .20
Prussiate, yellow, casks, lb.	.16 – .17
Sal ammoniac, white, casks, lb.	.0515 – .06
Salsoda, bbl., 100 lb.	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb.	1.05 –
Dense, bags, 100 lb.	1.15 –
Soda, caustic, 76%, solid, drums, 100 lb.	2.30 – 3.00
Acetate, del., bbl., lb.	.05 – .06
Bicarbonate, bbl., 100 lb.	1.70 – 2.00
Bichromate, casks, lb.	.07½ – .08
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb.	.03 – .04

CHEM. & MET.
Weighted Index of Prices for
OILS & FATS

Base = 100 for 1937

This month	145.56
Last month	145.04
November, 1943	145.24
November, 1942	140.27

Chlorate, kegs, lb	.06½ –	.06¾
Cyanide, cases, dom., lb	.14½ –	.15
Fluoride, bb., lb	.07 –	.08
Hyposulphite, bbl., 100 lb	2.40 –	2.50
Metasilicate, bbl., 100 lb	2.50 –	2.65
Nitrate, bulk, 100 lb	1.35 –	
Nitrite, casks, lb	.06½ –	.07
Phosphate, tribasic, bags, lb	2.70 –	
Prussiate, yel., bags, lb	.09¼ –	.10
Silicate, 40°, dr., wks., 100 lb	.80 –	.85
Sulphide, bbl., lb	.02¼ –	
Sulphite, crys., bbl., lb	.02½ –	.02¾
Sulphur, crude at mine, long ton	16.00 –	
Dioxide, cyl., lb	.07 –	.08
Tin crystals, bbl., lb	.39½ –	
Zinc chloride, gran. bbl., lb	.05½ –	.06
Oxide, lead free, bag, lb	.07½ –	
Oxide, 5% leaded, bags, lb	.07½ –	
Sulphate, bbl., cwt	3.85 –	4.00

OILS AND FATS

Castor oil, No. 3 bbl., lb	$0.13½ –	$0.14¼
Chinawood oil, tanks, lb	.38½ –	
Cocoanut oil, ceylon, dr. N.Y., lb.	.0885	
Corn oil crude, tanks (f.o.b. mill), lb	.12½ –	
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½ –	
Linseed oil, raw, car lots, bbl., lb.	.155 –	
Palm, casks, lb	.0865 –	
Peanut oil, crude, tanks (mill), lb.	.13 –	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tank, lb	.11½ –	
Menhaden, light pressed, dr., lb	.116 –	
Crude, tanks (f.o.b. factory) lb.	.08½ –	
Grease, yellow, loose, lb	.08½ –	
Oleo stearine, lb	.09½ –	
Oleo oil, No. 1, lb	.11½ –	
Red oil, distilled, bbl., lb	.12 –	
Tallow extra, loose, lb	.08½ –	

COAL-TAR PRODUCTS

Alpha-napthol, crude, bbl., lb	$0.52 –	$0.55
Alpha-naphthylamine, bbl., lb	.32 –	.34
Aniline oil, drums, extra, lb	.15 –	.16
Aniline, salts, bbl., lb	.22 –	.24
Benzaldehyde, U. S. P., dr., lb	.85 –	.95
Benzidine base, bbl., lb	.70 –	.75
Benzoic acid, U. S. P., kegs, lb	.54 –	.56
Benzol, 90%, tanks, works, gal	.15 –	
Benzyl chloride, tech., dr., lb	.23 –	.25
Beta-naphthol, tech., drums, lb	.23 –	.24
Cresol, U. S. P., dr., lb	.11 –	
Cresylic acid, dr., wks., gal	.81 –	.83
Diphenyl, bbl., lb	.15 –	
Diethylaniline dr., lb	.40 –	.45
Dinitrotoluol, bbl., lb	.18 –	.19
Dinitrophenol bbl., lb	.22 –	.23
Dip oil, 15%, dr., gal	.23 –	.25
Diphenylamine, dr. f.o.b. wks., lb.	.60 –	
H. acid, bbl., lb	.45 –	.50
Hydroquinone, bbl., lb	.90 –	
Naphthalene, flake, bbl., lb	.07 –	.07¼
Nitrobenzene, dr., lb	.08 –	.09
Paracresol, bbl., lb	.41 –	
Para-nitraniline, bbl., lb	.47 –	.49
Phenol, U. S. A., drums, lb	.10½ –	.11
Picric acid, bbl., lb	.35 –	.40
Pyridine, dr., gal	1.70 –	1.80
Resorcinol, tech, kegs, lb	.75 –	.80
Salicylic acid, tech., bbl., lb	.26 –	.33
Solvent naphtha, w.w., tanks, gal.	.27 –	
Tolidine, bbl., lb	.86 –	.88
Toluol, drums, works, gal	.33 –	
Xylol, com., tanks, gal	.26 –	

MISCELLANEOUS

Casein, tech., bbl., lb	$0.19 –	$0.24
Dry colors		
Carbon gas, black (wks.), lb	.0335–	.30
Prussian blue, bbl., lb	.36 –	.37
Ultramarine blue, bbl., lb	.11 –	.26
Chrome green, bbl., lb	.21½ –	.30
Carmine, red, tins, lb	4.60 –	4.75
Para toner, lb	.75 –	.80
Vermilion, English, bbl., lb	2.25 –	2.30
Chrome, yellow, C. P., bbl., lb.	.14½ –	.15½
Gum copal, congo, bags, lb	.09 –	.30
Manila, bags, lb	.09 –	.15
Demar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, calc., ton	64.00 –	
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	6.71 –	
Shellac, orange, fine, bags, lb	.39 –	
Bleached, bonedry, bags, lb	.39 –	
T. N. bags, lb	.31 –	
Turpentine, gal	.89½ –	

NEW CONSTRUCTION

	Current Projects		Cumulative 1944	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$75,000	$680,000	$980,000	$3,517,000
Middle Atlantic	1,790,000	335,000	9,057,000	14,478,000
South	159,000	.....	14,616,000	25,478,000
Middle West	464,000	.....	21,046,000	29,966,000
West of Mississippi	887,000	4,300,000	44,282,000	34,572,000
Far West	5,000,000	50,000	12,899,000	14,367,000
Canada	75,000	570,000	9,587,000	6,971,000
Total	$8,450,000	$5,935,000	$112,467,000	$129,349,000

PROPOSED WORK

Conn., Derby—Sponge Rubber Products Co., Derby, is having plans prepared by Leo F. Caproni, Engr., 1221 Chapel St., New Haven, for the construction of a factory. Estimated cost $75,000.

La., Logansport—Southern Natural Gas Co., Watts Bldg., Birmingham, Ala., plans to construct a dehydration plant. Estimated cost $75,000.

Mich., Detroit—U. S. Rubber Co., 6600 East Jefferson Ave., is having plans prepared by Lockwood Greene Engineers, Inc., 10 Rockefeller Plaza, New York, N. Y., for an addition to its plant.

Mont., Billings—North Pacific Pipe Line Co., c/o R. Hines, Pres., Billings, plans to construct 1100 mi. 10 in. crude oil pipe line carrier between Billings area (Harlowton), Mont., and Seattle, Wash. Estimated cost $15,000,000.

N. J., Newark—Fiske Bros. Refining Co., 129 Lockwood St., Newark, is having plans prepared by Robert E. Klemm, Archt., 944 Broad St., for the construction of a 2 story, 75x175 ft. manufacturing building and warehouse. Estimated cost $100,000.

N. J., Secaucus—Callite Tungsten Manufacturing Co., 540 39th St., Union City, N. J., plans to construct a 1 and 2 story metal salvage building. Binda & Bial, 2902 Bergenline Ave., Union City, Archts. Estimated cost $40,000.

N. Y., Ballston Spa—American Hide & Leather Co., Ballston Spa, plans to construct a new factory building. Kies & Halroyd, 257 Bway, Troy, Archts. Estimated cost $250,000.

O., Akron—Goodyear Tire & Ruber Co., c/o Mr. Armstead, 1144 East Market St., plans to construct a 1 story, 80x160 ft. laboratory and synthetic rubber research plant. J. Gordon Turnbull, 2630 Chester Ave., Cleveland, Engr.

O., Barberton—Seiberling Rubber Co., 345 15th St., plans to construct a 3 story, 60x80 ft. addition to Factory No. 50. Estimated cost $50,000.

O., Cincinnati—Gulf Refining Co., Gulf Bldg., Pittsburgh, Pa., plans to construct additions to its refinery. Estimated cost $334,286.

Pa., Rouseville—Pennzoil Co., Drake Bldg., Oil City, will construct a 1 and 2 story dewaxing plant here. Estimated cost $1,400,000.

Tex., Raymondville—Southwestern Cotton Oil Mill, Inc., c/o J. W. McKelvey, South Commerce St., Harlingen, Tex., plans to construct a cotton oil mill here. Estimated cost $100,000.

Tex., Robstown—Stanolind Oil & Gas Co., Gulf Bldg., Houston, and Seaboard Oil Co. of Delaware, Continental Bldg., Dallas, plan to construct a pressure maintenance plant. Estimated cost $100,000.

Tex., San Diego—Duval Gasoline Co., San Diego, plans to construct a recycling plant unit. Estimated cost $100,000.

Tex., Waco—Owens-Illinois Glass Co., Waco, plans to construct a glass smelting furnace. Estimated cost $587,308.

Wash., Seattle—North Pacific Pipe Line Co., c/o R. Hines, Pres., Billings, Mont., plans to construct a 40,000 bbl. daily capacity refinery. Estimated cost $5,000,000.

W. Va., South Charleston—Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York, N. Y., plans to construct an addition to its plant here. Estimated cost $84,000.

Que., Quebec—Goodyear Tire & Rubber Co. of Canada, Ltd., 19 Rue de la Canrome, plans to construct 1 story, 64x103 ft. warehouse and office building. Estimated cost $75,000.

CONTRACTS AWARDED

Calif., Bakersfield—Ohio Oil Co., 437 South Hill St., Los Angeles, has awarded the contract for a gasoline refinery and cycling plant to Fluor Corp., 2500 Atlantic Blvd., Los Angeles. Estimated cost will exceed $500,000.

Mass., Charlestown—Davidson Rubber Co., 50 Brighton St., has awarded the contract for the construction of a 1 story 35x77 ft. and 55x150 ft. factory and office building to Sawyer Construction Co., 31 St. James Ave., Boston. Estimated cost $55,000.

Mass., Chelsea—Panther-Panco Rubber Co., Inc., 31 Highland St., has awarded the contract for steel for 1 and 3 story, 150x680 ft. factory to Bethlehem Fabricators, Inc., 44 School St., Boston; fence barricades to Harty-Blaney Construction Co., 25 Huntington Ave., Boston. Total estimated cost $615,000.

Pa., Brownsville—Park & Tilford Distillery, Inc., W. J. Hossman, Res. Mgr., 1220 Water St., has awarded the contract for design and construction of a plant to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia. Project will be financed by Defense Plant Corp. Estimated cost $335,000.

Tex., Bishop—Celanese Corp. of America, Bishop, and 180 Madison Ave., New York, N. Y., has awarded the contract for design and construction of a butadiene plant to Gasoline Plant Construction Corp., Second Natl. Bank Bldg., Houston. Estimated cost $2,750,000.

Tex., Odessa—Defense Plant Corp., Wash., D. C. will construct channel type carbon black plant here to be operated by United Carbon Black Co., Inc., Charleston, W. Va. Owner will award separate contracts for work. Estimated cost $300,000.

Tex., Ringgold—Sinclair Refining Co., Fair Bldg., Fort Worth, will construct a new crude oil booster station to have a daily capacity of 5,000 bbl. Work will be done by owners. Estimated cost $50,000.

Tex., Sun Ray—Continental Carbon Co., Sun Ray, has awarded the contract for design and construction of carbon black plant to United Engineers & Construction Co., 1401 Arch St., Philadelphia, Pa., at $1,200,000.

N. B., Moncton—Canadian Liquid Air Co., Ltd., 1111 Beaver Hall Hill, Montreal, has awarded the contract for an oxygen producing plant to Parsons Construction Co., Ltd., Imperial Block, Moncton. Estimated cost $90,000.

Ont., Toronto—Colgate-Palmolive-Peet, Ltd., 64 Natalie St., has awarded the contract for a plant addition to Foundation Co. of Canada, Ltd., 1158 Bay St. Estimated cost $400,000.

Que., Montreal—Canadian Liquid Air Co., Ltd., 1111 Beaver Hall Hill, has awarded the contract for a plant addition on Rouen St., to W. G. Hunt Co., Ltd., 1405 Bishop St. Estimated cost $40,000.

Que., Westmount—Bristol-Myers Co., of Canada, Ltd., 3035 St. Antoine St., has awarded the contract for a plant addition to J. L. Gnay & Bro., Ltd., 437 Guy St. Estimated cost $40,000.